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ELECTRICAL WORLD AND ENGINEER.

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A "GRAND OLD MAN."

Congratulations are being extended in Europe to Lord Kelvin on the interesting fact that he has just attained the age of eighty, having been born June 26, 1824, and a host of American friends and admirers will join in this tribute of esteem to the Nestor of electricity and physics; while all on this side have been glad to note the reception given to him at the recent Anglo-American dinner in London. It is encouraging to learn that our distinguished and ever loyal friend, whose kindly words and criticisms as to American development have always been warmly appreciated, is in excellent health; and that while the life work has already been rounded out in splendid achievement, the intellect that has been so much a leading force in research and invention for fifty years has all its pristine keenness and activity. Lord Kelvin will forgive us if we apply to him affectionately the phrase "grand old man," because his perennial youth almost makes us hesitate to take the liberty.

COSTS OF MOTORS AS EFFECTED BY SPEED.

In the May number of the *Journal* of the Institution of Electrical Engineers is a paper by Mr. H. M. Hobart on "The Rated Speed of Electric Motors as Affecting the Type to be Employed." The conclusions reached in this paper are of great practical interest. The author analyzes a number of designs for a motor of 150 hp, both of the ordinary direct-current type and of the old pole-phase induction motor type. It appears that, in general, the cost of induction motors, as manufactured in England, is decidedly lower than the cost of direct-current motors of the same power, averaging in fact about one-third less. As the speed of rotation and peripheral speed are diminished, the cost of both types of machines increases; but the difficulties increase more rapidly with the alternating motor, so that at the lowest speeds the direct-current motor is both cheaper, better and more efficient. On the other hand, as the speed of rotation and the peripheral speed are increased the advantage particularly favors the alternating-current motor, so that at very high speeds the induction motor is not only much cheaper, but also considerably more efficient.

This conclusion is in line with the results of experience in this country, at least as to efficiency, for the relative purchasing costs of induction motors have never been distinguished for modesty on this side of the Atlantic. It is known that where low motor speeds have to be secured, and particularly a considerable range in speeds, the direct-current motor is preferable; whereas, when constant high speeds are desired without much starting and stopping, the induction motor is ideal. It is shown that the factory cost of constructing a motor is approximately proportional to the product DL of the diameter and length of the armature over the winding (not including the commutator). That is, if a longitudinal section of the armature core be drawn through the axis, the area of this section will be proportional to the factory cost of the motor, whether direct or alternating current, the coefficient of cost for the alternating-current induction motors being less than that of direct-current motors. If the ratio of length to diameter of armature remained constant, the volume of material would increase as D^2L, or within a constant, as D^3. The DL formula means, therefore, that the cost of labor in construction bears a steadily reducing ratio to the cost of material as the size increases, and thus the cost of the machine does not advance in proportion to the mass of material involved.

THE INVERTED REPULSION MOTOR.

Since the circuits of a repulsion motor are in many respects similar to those of a stationary transformer, it seems at first glance quite obvious that, if a proper value of impressed e.m.f. be used, the machine can be operated inverted; that is, with primary and secondary circuits interchanged. To one giving merely a passing thought to the subject, it might appear that the performance in the one case would be quite similar to that in the other; and since only a relatively low e.m.f. could be impressed upon the commutator, that a decided advantage would be gained by using as primary stator coils capable of being wound for any convenient e.m.f. A more careful study, however, reveals the fact that, when operated inverted, the repulsion motor develops distinctly different characteristics from those under normal conditions, and the difference in performance is attributable to the counter e.m.f. of rotation produced at the commutator. With the rotor stationary, the repulsion and the inverted motors show equal torques per kilovolt-ampere input and equal power factors, the motor windings in each case being those of a stationary transformer with secondary on short-circuit. With the inverted motor, the counter e.m.f. of rotation produces an effect similar in all respects to the insertion of resistance in the primary circuit of the transformer—decreasing the current and the core magnetism and increasing the power factor indefinitely with increase of speed. With the repulsion motor the effect of the motion of the secondary is not only not to cause a decrease in core magnetism, but also to allow the magnetism to increase, and the exciting ampere-turns must, therefore, be increased. Since, however, the secondary current is caused to lead the primary e.m.f. in phase, the exciting ampere-turns need not be supplied wholly by primary current, and the effect of speed on the motor circuits is similar to the insertion of resistance and some condensance in the secondary circuit of the transformer. The repulsion motor is practically a constant magnetism machine, while the inverted motor is of the variable magnetism type.

The statements here made are explained analytically and graphically by Mr. Karl Faber on page 93 of this issue. The author states that the commutation of the inverted motor is inferior to that of the repulsion motor, due to the absence of the revolving field in the former machine. As far as concerns the commutation, the circuits of the inverted machine are similar to those of a compensated series motor, and experiments show that in neither the case of the inverted nor the repulsion motor is the sparking destructive, and the difference in the commutation of the two machines is inappreciable. As stated by the author, the inverted motor should be much lighter than the repulsion motor, and for traction service the former machine seems to be superior to the latter, which necessitates both a transformer and a motor located in the limited space available upon a car truck.

THE CONGRESS OF ARTS AND SCIENCES AT THE UNIVERSAL EXPOSITION AT ST LOUIS.

During the week following that of the International Electrical Congress at St. Louis, in September, there is to be held perhaps the most unique Congress that ever convened. Its most attractive feature is that none can escape being interested in some section of its subdivisions. It is hard to think of any human interest or activity that is not somehow represented. There is no bug in earth or sky or water so minute or rare as to escape the Congress. There is no 'ologist who can keep out. All human knowledge is taken as its province, like the studies of Moses and of Bacon. All knowledge is divided—on the Congress programme—into 129 parts, of which the first on the list is metaphysics, and the last is the influence of religion on civilization. The classification which has been adopted is novel and somewhat unusual. There are 79 'ologies in the theoretical group of sciences, and 50 in the practical group. Among the theoretical sciences there are seven philosophies, three kinds of mathematics, thirty-one types of history, three sorts of physics, four chemistries, three astronomies, eight sciences of the earth, ten biologies, three anthropologies, four psychologies and three sociologies. In the practical sciences there are twelve medical sciences, six technologies, seven kinds of economy, five sorts of politics, five sets of law, six social sciences, five social cultures and four religions.

Although this particular method of classification is open to awe and criticism, yet it should in fairness be remembered that any attempt to pigeon-hole all the 'ologies and branches of human thought would probably elicit criticism or adverse comment from some specialty or 'ism. Electricity comes in twice for a hearing, once under physics and once under electrical engineering. The same is true of Buddhism, which comes in once under the history of religion and again under missions. The value of the Congress is to be found in its universality of interest. If it represents Science on the one hand, yet on the other it is popular by reaching every interest. Moreover, if in a tentative way all the various branches of science may be brought into a little closer association by the convention, the St. Louis Congress of Arts and Sciences will have done good work. The plan is grandiose and we hope those having charge of its execution will be successful in securing as spokesmen for the various branches of knowledge on the programme men of such high attainment in each branch that the published proceedings will constitute a real epitome of present-day human knowledge.

TRANSMISSION PROGRESS ON THE COAST.

The Pacific Coast Electric Transmission Association is an organization altogether too little known to the Eastern contingent. Long-distance power transmission got its first start as a practical business in California, where dear coal guaranteed a market, and an enterprising community went ahead and did things while the rest of the country was considering the subject. The result of this early beginning has been the continued pre-eminence of the coast in working out the practical features of long-distance transmission. The Association represents the men who are pushing the art along, and the papers brought before it are, as a rule, of much practical value. The convention just held brought out much interesting matter, and we are making no invidious comparison in saying that its proceedings have at least as important bearing on power transmission as those of the A. I. E. E. meeting concurrently held in Chicago. The range of topics covered was a wide one, and we can touch it at only a few points, meanwhile advising our readers to study the abstract published elsewhere in our columns.

A paper which seems to have attracted much attention was one upon the determination of motor rates by Mr. A. M. Hunt. This has been a moot point in electrical station practice for some years past, and the need of a decision has been acutely felt on the coast, where motor business is relatively very important, and Mr. Hunt's plan was one of the type designed to obviate irregularities of rate, while providing a sliding scale based on monthly consumption. We have seen many such efforts to avoid finite differences in a sliding scale, and while they uniformly are plausible and look well on paper, we must own to finding them unconvincing from the standpoint of practice—and of human nature. The average citizen who sees his meter reading reduced to a bill *via* a differential equation or its graphical equivalent, has a lurking suspicion that the company is deftly doing him, and growls accordingly. He will growl anyhow, doubtless, but it has always seemed to us that in making rates simplicity was of more importance than theory. The station desires

to sell its product to the best advantage and the consumer wants to buy it cheaply—and the more direct and open the dealings the better for both. A simple set of discounts based on consumption plus a guaranteed minimum bill to take care of the capacity question, will meet the average case pretty satisfactorily. In the discussion following Mr. Hunt's paper there was an evident sentiment to this effect, some speakers even favoring a straight flat rate as leading to better relations with customers.

Of the more technical papers the most noteworthy was a group dealing with various features of the single-phase system in its application to transmission and railway service. For general transmission purposes the consensus of opinion indicated distrust of single-phase motors except in very small sizes and a good bit of doubt as to the practical usefulness of the proposed single-phase railway system. Mr. Lamme's paper on this latter topic contains, by the way, a statement in which we heartily concur, namely, that the proper place for the trolley conductor is either overhead or underneath, but certainly not upon the surface, and that with the high voltage upon the working conductor used in alternating practice, heavy trains could be successfully worked from overhead trolleys. It was incidentally brought out, however, that one of the interurban lines near San Francisco was already operating six and eight-car trains with direct current taken off by a special under-running trolley —which belong, by the way, to a class widely used abroad, but condemned by the wise men of the East. Our besetting sin on this side of the continent is knowing so many things that are not so about the perfection of "standard" apparatus.

As to some of the features of high-voltage work, a paper by Mr. Masson detailed experimental results from a 16-mile line worked experimentally in testing out insulators up to 80,000 volts. The conclusion reached that 60,000 volts is a pressure entirely practicable on a long line merely confirms the results already reached on other Coast lines, but inferentially it seems clear that between 60,000 and 80,000 volts the line of practicability with insulators now available was crossed. As to secondary voltages, it is worth noting that there is a rapidly increasing use of 200-volt incandescent lamps on the coast, and that the Nernst lamp is coming into considerable use as a substitute for the alternating-current arc. It is evident enough that the distribution of light from the Nernst lamp for indoor work at least is better than that from an arc, its efficiency is fully as high and its color incomparably better. The use of the 200-volt incandescent at Coast values of power seems odd at first sight, but coast towns are, as a rule, rather scattered, and if one is to obtain the advantage of large transformers and secondary mains, the working pressures must be kept high. Altogether we must recognize the fact that advanced practice in power transmission is at home on the Coast, and that engineers there are quietly doing the things that the rest of the country is solemnly debating. That the results of the valuable experience gained there should not receive a wider publicity than is possible through the proceedings of the local professional organizations is a great pity. Whether it is that the Coast engineers are, through sectional spirit, holding aloof from the American Institute of Electrical Engineers, or that the national body has been lax in recognition of the Slope contingent of the profession, the present separation in this day of scientific co-operation and professional solidarity is creditable to neither body. With its fine record of some years it might now be difficult to bring the Slope organization within the fold of the national body, but in the best interests of the profession at large, such a consummation is devoutly to be wished. It is sincerely to be hoped that some administration of the Institute will devote its best energies to the attempt.

ORGANIZATION AND WORK OF THE BUREAU OF STANDARDS AT WASHINGTON.

A good account of the organization of the Bureau of Standards was published in a recent number of *Science*. Congress has appropriated over half a million dollars for the erection and equipment of the Bureau. It would be difficult to find any better investment of national funds than this. The returns anticipated are of two kinds. One is the material advantage of standards established, comparisons and tests made, technical appeals settled and calibrations offered to manufacturing industries. The other is an intangible advantage accruing to the creation at Washington in the Bureau of a center of knowledge in the applied sciences, that not only makes for material progress, but also establishes national prestige. The prestige of the German Technical Reichsanstalt at Charlottenburg is as distinct an asset of the German Empire as the German army or navy, and probably this Technical Department has a greater influence on intellectual and material progress than any other German institution.

The Bureau is organized in three divisions, which may be roughly characterized as the physico-mechanical, the electrical and the chemical divisions, respectively. It is already the American Court of Appeal and last resort in the matter of weights and measures. Two copies of the international meter are kept there. Two copies of the international kilogram are also in charge of the Bureau. These are the Lares and Penates of the department, and on the safe-guarding and reduplication of these standards, all of the national weights and measures may be said to depend. It is not generally known that ever since the Act of Congress of 1893, the fundamental standard of length of the United States is the international meter, as kept in the original at Paris, the yard being 3600/3937 of this meter. Similarly, the standard United States mass is the international kilogram. The old standard yard and the old standard troy pound are already matters of ancient history, so that, although the grotesque and burdensome tables, names and cross-ratios of the British system still persist among us by inertia, further divergence is arrested by strict adherence to the metric standard of the world. The Bureau verifies any length measures between one decimeter and 50 meters; any weight measures between 0.1 milligramme and 20 kilogrammes; any volume measures from 1 c.c. to 40 liters, and any thermometer from —200° to +550° C. In electrical measures, the legal standard of e.m.f. in the United States is the Clark cell, established as 1.434 volts at 15° C. The Reichsanstalt assumes for the e.m.f. of the Clark cell the value 1.4328 at 15° C., so that there is a discrepancy at present of nearly 1 part in 1,000 between the legal standards of the two countries. This is a deviation to the correction of which the coming International Electrical Congress at St. Louis might well give attention.

The great value of a Standardizing Bureau as a civilizing agency is the fact that all its work necessarily draws from and returns to the great science of the universe, to which every such institution must be led to conform by its own work. The work of our Bureau tends, therefore, to bring us nearer to the work of the similar English, French and German Bureaus, thereby keeping unity and uniformity in the work and measures of all men. The more nearly nations can be drawn in their work and thought, the more clearly they learn each other's purposes and activities, and the more rapidly intelligent intercommunication can subjugate blind and egotistic war. Like every other institution, the power of influence of the Bureau will depend upon the individual work and capacity of its officers much more than on its physical conditions and equipment. From the roll of its present personnel, great success is to be looked for, so far as prediction may glance along the path of the future.

Selection of Architect for United Engineering Building.

The Conference Committee of the three national engineering societies and of the Engineers' Club, charged with the responsibility of giving effect to the gift of Mr. Andrew Carnegie of $1,500,000 for the erection of two buildings in New York City suitable for their respective purposes, has reached an important stage in its work and this week has made the selection of architects for the individual structures. It was the expressed wish of Mr. Carnegie that the competition should be a mixed one, so that in addition to selecting six competent architects the committee threw the work open to all comers and provided a prize scheme to compensate the best competitors in the open class. Since the middle of June the committee has received 26 complete sets of competitive plans for the two buildings inclusive, comprising over 500 drawings, and with the assistance of Prof. W. R. Ware, as expert adviser, has spent a good deal of time in the consideration of these designs, all of which, of course, were submitted anonymously. The conclusions now reached are unanimous and are approved by the professional adviser. The successful competitor for the United Engineering Building is Mr. Herbert D. Hale, of Boston, with Henry G. Morse, of New York, as associate architect. Mr. Hale is a grandson of Edward Everett Hale and has done a large amount of public architecture in New England and has constructed some Carnegie libraries, besides doing a very considerable amount of work for the New York Shipbuilding Company. The successful competitors for the Engineers' Club are Whitfield & King, of New York, who have done a large amount of work in New York City and on some Carnegie libraries and were also associated in work on the buildings of the Pan-American Exposition. The designs of this firm were also among those favorably considered for the United Engineering Building, awarded to Mr. Hale. The successful competitors in the open class for four equal prizes of $400 each in addition to Mr. Hale are Trowbridge & Livingston, of New York; Frank C. Roberts & Co., with Edgar V. Seeler associate, Philadelphia, and Allen & Collins, of Boston. It is interesting to note that a very large proportion of the competitive designs came from Boston and that the largest prize, namely, the award for the United Engineering Building, as well as one of the smaller money prizes, has gone to that city.

Details have already been made public as to the nature of the two buildings, which will require for construction from $1,100,000 to $1,200,000. The United Engineering Building will occupy land 125 ft. front by 100 ft. on West Thirty-ninth Street, while the club, with a frontage of 50 ft. and a depth of 100 ft., will face on Bryant Park and the new Public Library. The United Engineering Building, aside from quarters for the American Society of Mechanical Engineers, the American Institute of Electrical Engineers and the American Institute of Mining Engineers, as well as other societies enabled to participate in the accommodations, will have several fine auditoriums and a magnificent library. The club building will be about 11½ stories high with the usual accommodations of a club and some 60 or 70 bedrooms for members. The work of tearing down the old buildings and the construction of the new is to be pushed vigorously and will begin forthwith.

The Kellogg-American Bell Litigation.

Mr. Milo G. Kellogg has issued a statement concerning the present status of the litigation having for its object to invalidate the sale of the controlling interest of the Kellogg Switchboard & Supply Company to the Bell interests. This statement is concurred in by Messrs. Francis W. Dunbar and Kempster B. Miller.

The case of the minority stockholders some time ago came before Judge Mack at Chicago, who sustained the demurrers of the Bell interest and decided that the Kellogg bill should be dismissed as not stating a good cause of action. The same decision was rendered on the demurrers to Mr. Kellogg's cross bill. Both decisions have been taken to the higher courts—by appeal to the Appellate Court and also on writ of error to the Illinois Supreme Court. If the Supreme Court decided to hear the case the argument there will be final and there will be no hearing before the Appellate Court.

The adverse decision of Judge Mack was based on the ground that the stock of the Kellogg Company had not been transferred to the American Bell Company, being held by certain individuals in trust for that company. Mr. Kellogg holds that if Judge Mack is right in this distinction, all that will be necessary to get around the United States Supreme Court decision in the Northern Securities case would be to place the stock of the underlying companies on their books in the name of an individual, say, J. Pierpont Morgan, as the trustee of the Northern Securities Company. Opinions are quoted adverse to the view on this point of Judge Mack, and it is stated that in the broadest phase of the case there are involved not only the right of the American Telephone & Telegraph Company to hold by itself or through an agent the control of the Kellogg Company, but also the question of its right to hold the control of the Western Electric, the Chicago Telephone and the Central Union Telephone Companies. Mr. Kellogg believes it is not at all improbable that the Supreme Court of the State will in the case at issue hold that it is illegal for the Bell Company to own the control of any of these.

It is pointed out that while the American Telephone & Telegraph Company retains the control of the Kellogg Company, neither it nor the other allied companies can maintain a patent suit against the customers of the Kellogg Company, and that the condition which exists amounts to a license to the customers of the Kellogg Company under all the Bell patents. He says that the Bell interest could avoid this condition of affairs and free itself from its licensing of the Kellogg Company's customers, by returning to him the stock on fair terms, and he stands ready and anxious to take it back. To his mind, the effect which the purchase of the Kellogg Company's stock has on patent litigation will be a very strong and practically unanswerable argument in the suit, to the effect that the Bell interest intended to obtain from the purchase of the stock ulterior and illegal advantages which would be of greater value to it than the loss of the use of the Bell patents; and that if the Bell interest continues holding the stock while the patent suits are tied up and the patents gradually nearing their termination, this fact will be considered by the telephone and investing public as proof that the Bell interest does not now consider its patents to be of any real value. In conclusion, Mr. Kellogg says he has confidence that the final result of the litigation will be to declare the holding of the Kellogg Company's stock by the Bell interest illegal and void, and to return the control of the Kellogg Company into his hands.

Cincinnati A. I. E. E. Local Meeting.

The Cincinnati local meeting of the American Institute of Electrical Engineers, held on the evening of July 6 at the Grand Hotel, took the form of a banquet in honor of Mr. Charles G. Y. King, mechanical engineer of the Chicago Edison Company, who, during the evening, gave a lecture illustrated by 100 slides, on "The Installation of the 5,000-kw Turbo-Generators at the Commonwealth Electric Company." The banquet was attended by some forty members and guests, the lecture being attended by about sixty. The meeting was presided over by Mr. B. A. Behrend, chairman, with Mr. L. E. Bogen as secretary. Before introducing the speaker, the chairman addressed the local members, calling their attention to the United Engineering Building, and asked them to take a broad view of the question, representing to them the advisability of contributing toward the building fund. A motion was made by Mr. E. M. Gerry to appoint a committee to solicit subscriptions from the local members toward the building fund. This motion was seconded by Mr. Thomas S. Allen and was unanimously carried. A committee of three will be appointed to solicit such contributions.

The chairman then introduced the subject by speaking of the importance of the steam turbine and of the wide field that it had already conquered. Instead of huge generators, 20 and 30 ft. in diameter, turning over at a slow rate of speed, we are building small generators 6 and 8 ft. in diameter, the surface speed of which equals three miles a minute! The design of the steam turbine and the turbo-generator requires all the knowledge of thermo-dynamics and the theory of elasticity that has been obtained by men of science and engineering, and the crude shop methods, the unskilled labor employed in the manufacture of the slow-speed reciprocating engine and generator, have to give way to refined methods guided by scientific principles.

Mr. King described the installation and erection of the first 5,000-kw steam turbine of the two-stage type, graphically illustrating the subject by means of very good pictures. A discussion was opened by the chairman and was participated in by Messrs. Ryland, Pomeroy, Van Phul, Senstius, Allen and Wessling. The meeting was one of the most successful held by the Cincinnati branch.

New Telephone Exchange at Buda-Pest, Hungary.

BY JOSEPH HOLLOS.

WHEN in 1897 the Hungarian Telegraph Administration took over the Buda-Pest Telephone Company, it was well known that not only would the subscribers' lines need to be changed from grounded to metallic circuits, as had already been done in the other Hungarian exchanges, but also that a new and modern switchboard must replace the four antiquated central offices. After a careful study of the local conditions, it was decided to concentrate all the Buda-Pest subscribers in a single central office, in order to attain the highest operating efficiency. Since, in spite of unfavorable circumstances, the number of subscribers was already between five and six thousand, it was desirable to make the new central office of very large capacity.

As to the system to be adopted, it was decided to put up the supply of the new plant to public competition. Tenders were received from several foreign manufacturers, some of them associated with Hungarian firms, among them being two American, one French, two German and two Swedish manufacturers, all of whom offered their most improved systems. After a thorough study of the tenders, that of the Western Electric Company was accepted, in combination with the Hungarian United Electric Company, of Buda-Pest-Ujpest.

The system adopted was virtually the American Bell, the "central battery," with a preliminary equipment for 10,000 subscribers and a capacity of 20,000. The switchboard row occupies one side of the switchroom, on the other side of which is space for a second row of the same capacity, so that the new exchange is capable of accommodating 40,000 subscribers. So far as can be learned, no single central office of these dimensions has yet been built anywhere, and hence a description of the main technical features of this plant will be of more than usual interest.

For the building 2,500 square meters of ground were purchased at about the central point of the exchange system. A six-story building was erected at a cost of $300,000, and was fitted with modern heating, lighting and ventilating appliances. This building occupies the whole space between two parallel streets and the switchroom, 64 by 10 meters and 7 meters high, runs lengthwise of the building, a transverse section of which is given in Fig. 1. The subscribers' switchboard is shown at *A*. The balcony above the entrance at one end of the room is designed to admit the public, who may desire to see the exchange in operation.

Fig. 2 shows the switchroom and switchboard. Immediately under the switchroom is a low story 2.30 meters high, containing the intermediate distributing board, the relay racks, the power plant, etc. There is a passage to the lower room under the switchboard at each operator's place. The switchboard cables thus pass directly to the intermediate distributing board and the relay rack. Similar openings are provided in the floor on the other side of the room for the second switchboard row.

Fig. 4 shows the lower room and Fig. 3 gives a more detailed view of the mode of mounting the relays. Three winding stairways in the axis of the switchroom lead to the floor below, and near the central one is a broad staircase for the use of the operators in entering and leaving the switchroom. There are two chief operator's desks set near the wall opposite the switchboard row, destined to be moved to the center of the room when the space is wanted for the second row of switchboards.

The switchboard row begins with a long-distance switching section for three operators, each of whom has 40 single cords, connected to the long-distance room. All the subscribers' jacks are multipled in this section, so that these switching operators can give direct connection to any subscriber in the exchange when required for the long-distance service.

The switching section, which is provided with nine jack panels, is slightly separated from the 22 subscribers' sections which follow. Each section has three operators' positions equipped for 150 subscribers each, there being a sixty-seventh position equipped for 100 subscribers, thus making a total equipment for exactly 10,000 subscribers' lines. End sections are provided at the beginning and end of the row, repeating one-third of the 10,000 subscribers' jacks in the usual manner. The subscribers' sections are 1.80 meters long and contain 10 jack panels, so that the numbering with a thousand jacks in each row of hundreds is decimal and perfectly symmetrical. Each operator's position is provided with 15 pairs of plugs and cords and with the corresponding listening and ringing keys arranged in the usual manner. The circuit is shown in Fig. 5, where the calling subscriber, *I*, is shown connected with the exchange, while the called subscriber's jack is being tested. The number of connections at each operator's position is registered by the operator, who, on pressing the button, *G*, actuates the recording mechanism, *S*, after completing each connection.

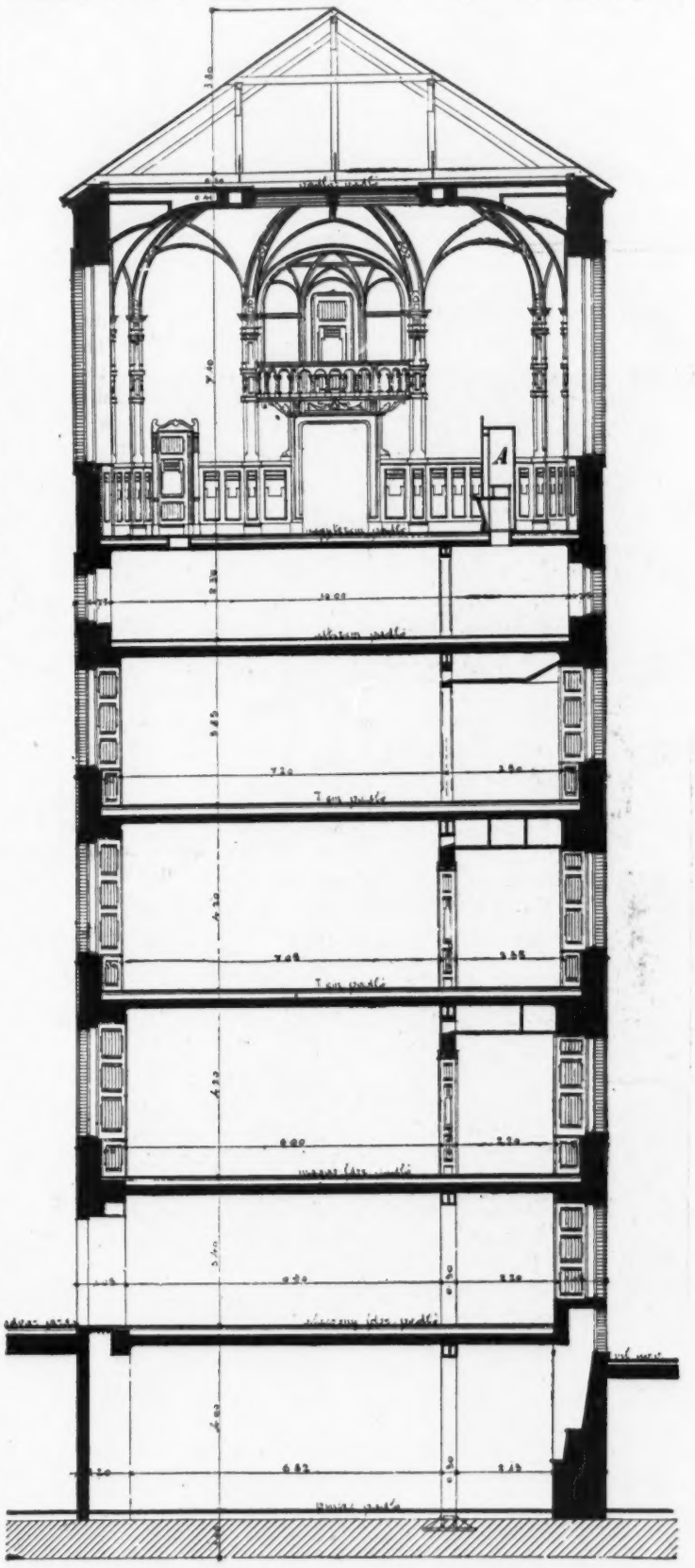


FIG. 1.—TRANSVERSE SECTION OF NEW TELEPHONE EXCHANGE, BUDA-PEST, HUNGARY.

For the detection of grounds the conductor, *B*, is connected over a lamp, *L2*, with the negative pole of the battery, the other conductor, *A*, being connected with the bus-bar of the ninth cell over the line relay. In case of grounding of the conductor, *A*, the line relay, *R1*, is operated, whereas in case of ground on the conductor,

B, the lamp, *L2*, is lighted by current from the 11-cell battery. The subscribers' transmitters are supplied when in use from the entire storage battery.

The lead pipe street cables are laid in cement conduits of the Hultman type, and enter the building in the basement, where the main distributing board is placed. Thence, small lead-covered cables pass up through a cable shaft to the switchroom. The power plant and storage battery are placed in close proximity to the switchboard and the relay racks, thus making the battery leads very short and consequently reducing the drop of potential to the requisite limits.

Adjoining the switchroom is the long-distance or tollroom, where all toll line connections are made. The plant here includes one testboard, one transit or through toll connection board with two operators' positions, three rows of tollboards with six positions each and six toll lines per position, one subscribers' recording board, one toll-recording board for 120 toll line subscribers, whose lines end directly on this board, in order to facilitate toll connections and avoid line troubles. This board has three operators' positions for 40 lines each.

FIG. 2.—OPERATING ROOM FLOOR, NEW TELEPHONE EXCHANGE, BUDA-PEST, HUNGARY.

These toll subscribers' lines are multipled on the toll boards and the transit board.

As the long-distance lines in Hungary are used for simultaneous telegraphy and telephony, and also for duplex working, it was found necessary to devise some special circuits shown in Fig. 6 to adapt the lines to these requirements. Section I represents the transit board circuit, which is used during the day for completing through toll line connections; at night all long-distance connections are made on this board. Section II shows the circuits of the tollboards. Section III shows the circuits in the switching section, which is located in the switchroom. The toll line, *L1*, *D1*, enters the transit board, whence it passes through a cut-off jack to the tollboard, there ending in a line relay, *R1*, with a holding coil. In case of a call and when the key, *K0*, is in the position shown, the calling lamp, *L1*, is lighted. Plugging the jack actuates the relays, *R2*, *R3*. Relay *R2* lights the lamp, *L2*, on the transit board, notifying the operator there that the circuit in question is busy. Relay *R3* interrupts the holding coil of the calling relay, *R1*. In case the toll line is in use at the transit board, relays *R3* and *R4* are actuated, and through *R4* the lamp, *L3*, is lighted, notifying the toll line operator that the line is busy at the transit board. To concentrate the whole toll line service at the transit board, the lever of key *K0* is thrown, and now all the calls are received on the lamp, *L4*, of the transit board. The two portions of the cord circuit, *L*, that is the long-distance to the left and the local subscriber to the right, are connected by a repeating coil, including on one side a condenser and on the other the central battery, which supplies current to the subscribers' transmitters. The long-distance circuits are, therefore, completely insulated, and simultaneous operation is in no way hindered.

Plugging the switching trunk, *T1*, actuates the differential relay, *Rd*, and lights the lamps, *L5* and *L6*. The number of the desired subscriber is given to the operator at the switching section over the order wire, *V*. With the plug, *I*, of the switching trunk, *T1*, the operator tests the jack of the desired subscriber's line; through the normal contact of the test relay, *Rc*, the tip of the plug is in connection with the third winding of the induction coil of the operator's set, so that, if the subscriber's line is already connected to a local circuit, the operator hears a click in her telephone. If, on the other hand, the subscriber's line is connected with a toll line, she hears a buzz or tone. In the first case, the connection is cut off, as toll line connections are always given precedence over the local service. In the second case the line is not disturbed. This cutting off is readily done as each subscriber's line passes thus a cut-off jack in the switching section. In order to explain the interruption to the second subscriber, the first being picked up at once by the toll operator, and to disconnect him quickly, the switching operator depresses the key, *B*, associated with each cord circuit, which locks the relay, *Rz*, to the third cord conductor. The low speed interrupter, *D*, is thus connected to the test ring of the subscriber's line, and causes the supervisory lamp at the subscriber's operator's position to flash at distinct intervals. On perceiving this unmistakable signal, the subscriber's operator tells the second subscriber that the

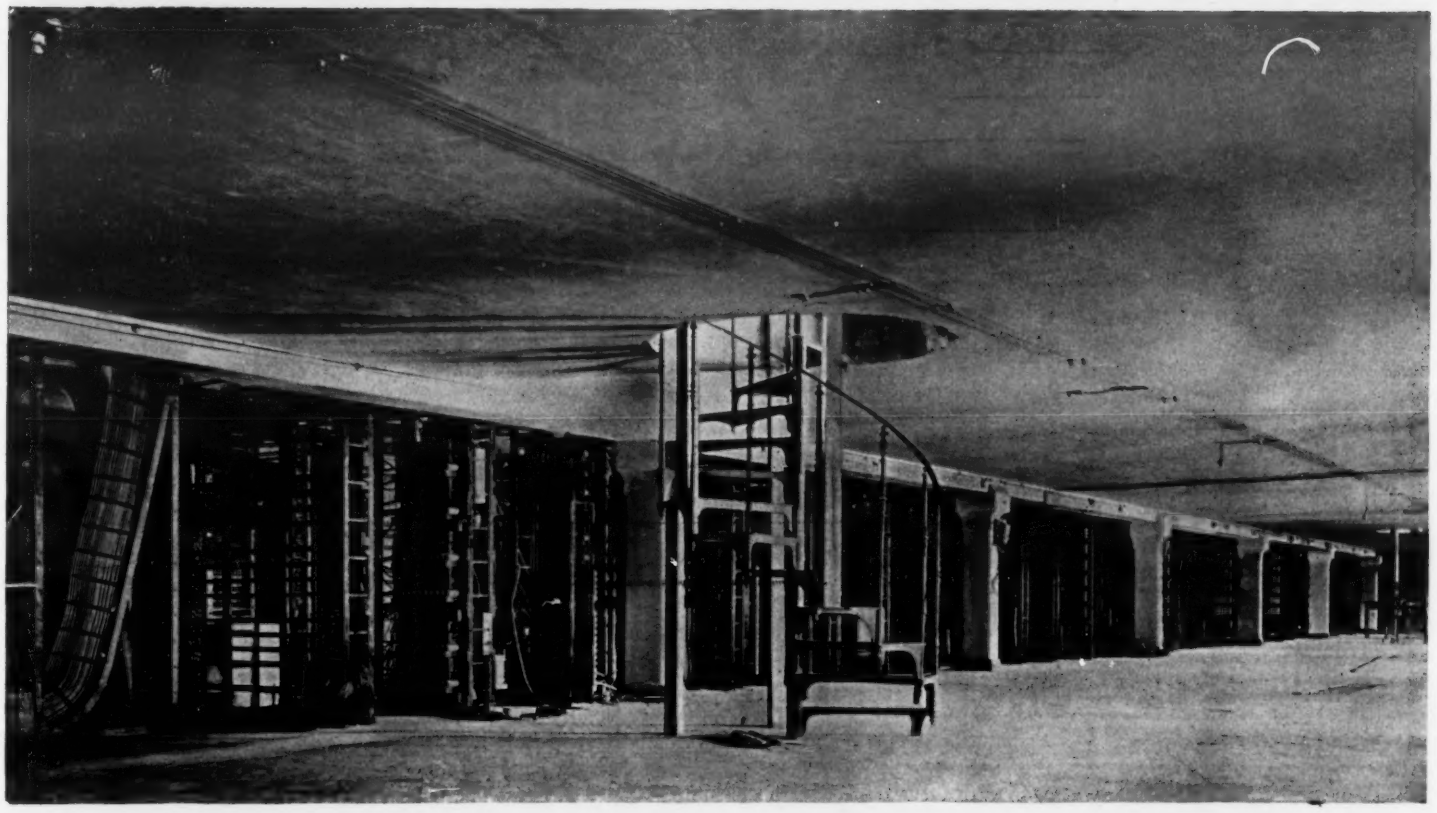


FIG. 3.—CABLEWAYS, RELAY RACKS, ETC.

FIG. 4.—INTERMEDIATE DISTRIBUTING BOARD, RELAY RACKS, ETC.

first has been called by the toll room, and disconnects the line. This disconnection causes the relay, *Rz*, to drop its armature, thus cutting off again the intermittent current from the third conductor. Press-

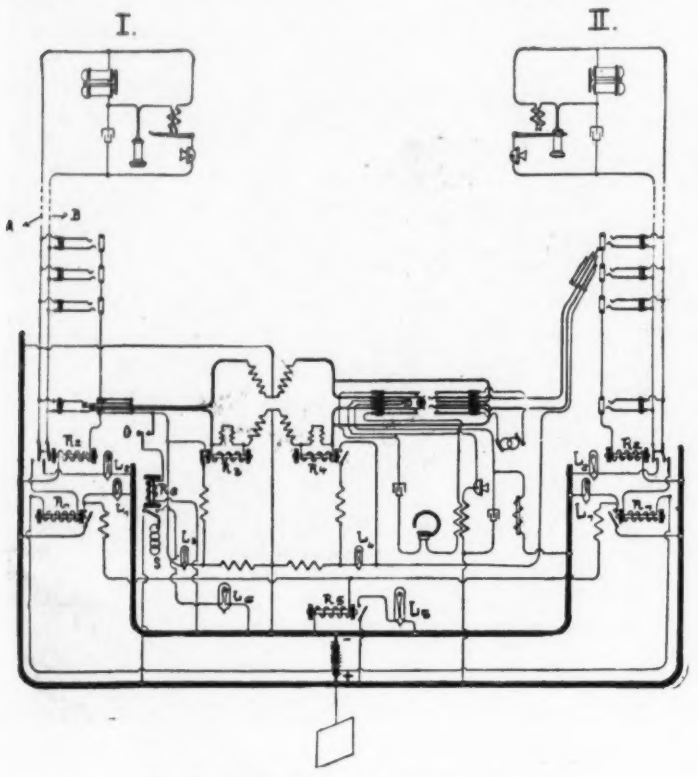


FIG. 5.—DIAGRAM OF OPERATING CIRCUIT.

ing the key, *B*, also actuates the relay, *Rt*, and lights the lamp, *Ly*, indicating that the intermittent current circuit has been completed.

As already mentioned, it is also possible to ascertain by testing whether a subscriber is in connection with a long-distance, which is brought about in the following manner: Through the third conductor of the cord, which places testing potential on the test rings of the multiple jacks, the battery current traverses the winding of the test relay, *Rc*. This relay has, however, a second winding, which by induction superimposes on the constant current flowing the intermittent current of high periodicity from the high-speed interrupter, *D*1. In testing the operator perceives thus a buzz or tone in her head telephone informing her of the toll line connection.

As already mentioned, the transit board performs a double duty. In the hours of heavy traffic the through connections of toll lines are made here. During light traffic it can be arranged so that all tollroom connections, including those of the recording and toll subscribers' lines, can be effected in addition to interconnecting toll lines. For this purpose the board is provided with three sets of cords and plugs. Plug *Di* can be used only for toll line jacks, being too small for the local jacks, whereas the plug *D*1 fits the latter. If the third key, *K2*, is in the position shown, only the two plugs, *Di, Di,* can be removed, the plug *D*1 being held in place mechanically. Therefore, only a connection between toll lines can be made and this only through the translator, *Tr*. This latter is designed to serve also as clearing-out relay controlling the clearing-out lamp. If, on the other hand, a toll line is to be connected to a subscriber's line, the lever key, *K2*, is thrown over, thus freeing the plug, *D*1, and mechanically locking the neighboring plug, *Di*. The cord connection is then completed through the repeating coil, *Trc*, which is of the same construction as the repeating coil of the toll line cords and similarly connected. The toll line circuits are thus kept separate, a condition essential to multiple work.

All order tickets are sent to the different boards and thence after use to the counting office by means of a special pneumatic tube distributing system, in which the tickets themselves without carriers are transported. The duration of toll line conversations is timed by three-minute clocks, the exactly elapsed time being recorded on the tickets by a calculagraph. The operators at the recording tables are informed of the number of orders for each toll line at any moment by colored lamps, and are thus able to inform the subscriber beforehand approximately when the toll line called for will be available.

The operation of the entire installation is very regular and goes on with precision, ease and smoothness. The whole installation has proved very satisfactory and does credit to both manufacturers and designers.

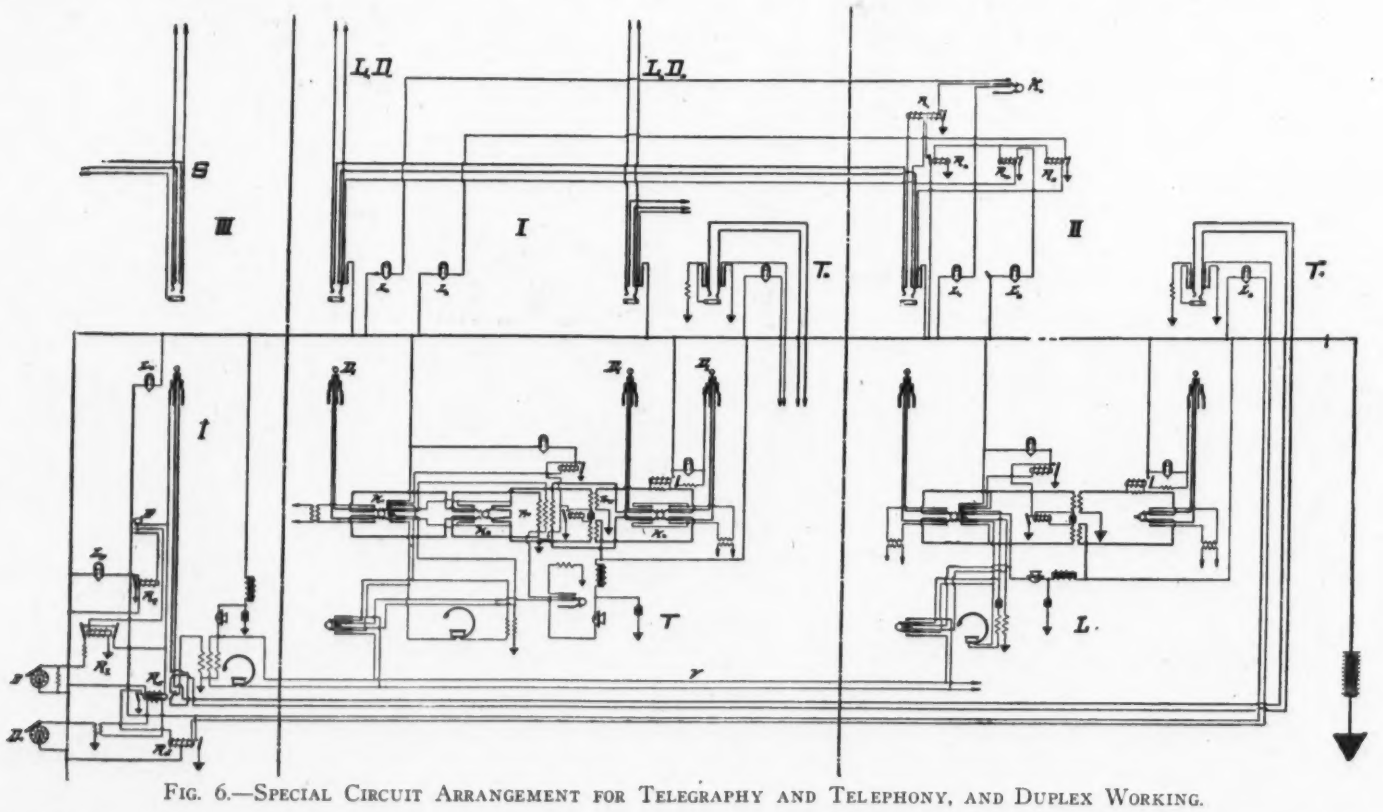


FIG. 6.—SPECIAL CIRCUIT ARRANGEMENT FOR TELEGRAPHY AND TELEPHONY, AND DUPLEX WORKING.

To Catch the Eye.

In a clever little illustrated pamphlet it has just issued for the information of the public the Philadelphia Electric Company, discussing the value and utility of electric signs, mentions the striking fact that more than 600 business houses in the city of Philadelphia are using such signs, equipped with over 20,000 incandescent lamps, all being supplied with current from the company's street mains.

The Inverted Repulsion Motor.

BY KARL FABER.

IF we connect the rotor of an ordinary repulsion motor to the line and short-circuit the stator, we obtain a new motor, the behavior of which in comparison with the plain repulsion motor shows some interesting features. By means of a simple geometrical reasoning I will develop its circle diagram in order to point out its working qualities.

Some of the objections that can be raised against alternating-current motors with a series characteristic are a greater weight and greater iron and copper losses than in the case of direct-current motors of the same output and characteristics. Besides these, the power factor approaches unity only during a small range of load. The foregoing holds true also for the repulsion motor with short-circuited armature. This will be evident from the following considerations:

The components of the primary current and the armature current, which together produce the torque, are never in phase with each other. Their phase difference is a minimum at starting and increases with the speed until both currents are in quadrature. The torque being proportional to the cosine of this angle decreases, therefore, very rapidly with the speed. In order to obtain a reasonable torque at higher speeds, comparatively large wattless currents are inevitable. To induce these currents a high flux density is necessary and, therefore, a large magnetizing current. As soon, however, as we take the rotor as primary and short-circuit the stator, the conditions improve in the following ways:

The impressed e.m.f. is now opposed by an e.m.f. which is induced by the rotation of the moving part, and it is only the remaining component of the impressed e.m.f. that produces the magnetizing current, while in the case of the plain repulsion motor the whole impressed e.m.f. has to be counterbalanced by the resulting flux. In the inverted repulsion motor, therefore, the magnetizing current and

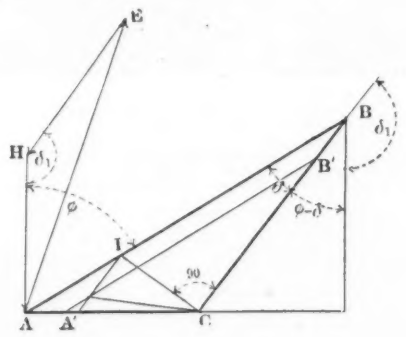


FIG. 1.—VECTOR DIAGRAM.

the resulting flux are, as soon as the motor is running, always smaller than in the former case, and are smaller the higher the speed.

This fact prevents an increase of phase difference between the primary and secondary currents. The phase angle is constant at all speeds and equal to that at starting. The secondary current is always smaller than in the case of the ordinary repulsion motor, as is also the resulting flux; and if the motor is run at a higher speed and with the same output as the ordinary repulsion motor, the power factor is also higher.

In the following discussion let:

i_1 = the current in the stator,
i_2 = the current in the rotor,
E = impressed e.m.f.,
Z = number of primary or secondary turns,
ζ_1 = magnetic reluctance of the stator or rotor flux,
i'_0 = magnetizing current of the rotor,
i_0 = magnetizing current of the stator,
ζ = magnetic reluctance of the resulting flux,
$v_1 = \frac{\zeta_1}{\zeta}$ the primary or the secondary leakage factor,
r = ohms resistance in the stator or in the rotor,
ϕ = phase angle between impressed e.m.f. and the rotor current,
n = number of revolutions per second,
a = shift of brushes.

Fig. 1 is the vector diagram of the inverted repulsion motor, in which

$A'B' = \frac{i_2 Z}{\zeta_1}$ represents the flux produced by the rotor current,

$B'C = \frac{i_1 \cos a \; v_1 Z}{\zeta_1}$ represents the component of the flux produced by the stator current interlinked with the rotor current in the direction of the brushes,

$A'C = \frac{i_0 Z}{\zeta_1}$ represents the resulting flux in the rotor in the direction of the brushes,

$BC = \frac{i_1 Z}{\zeta_1}$ is the flux of the stator current,

$IB = \frac{i_2 Z \; v_1 \cos a}{\zeta_1}$ is the component of the flux produced by the rotor current interlinked with the stator current in the direction of the axis of the stator coil,

$IC = \frac{i_0' Z}{\zeta_1}$ is the resulting flux in the stator in quadrature with i_1.

Since the triangle, ABC, is similar to the triangle, $A'B'C$, $AB = i_2 Z$; $AC = i_0 Z$; $IC = i_0' Z$; $BC = i_1 Z \cos a \; v_1$.

At the moment of starting when the speed is zero, the motor acts as a simple transformer with short-circuited secondary. If the construction data of the machine are known, the current, the phase

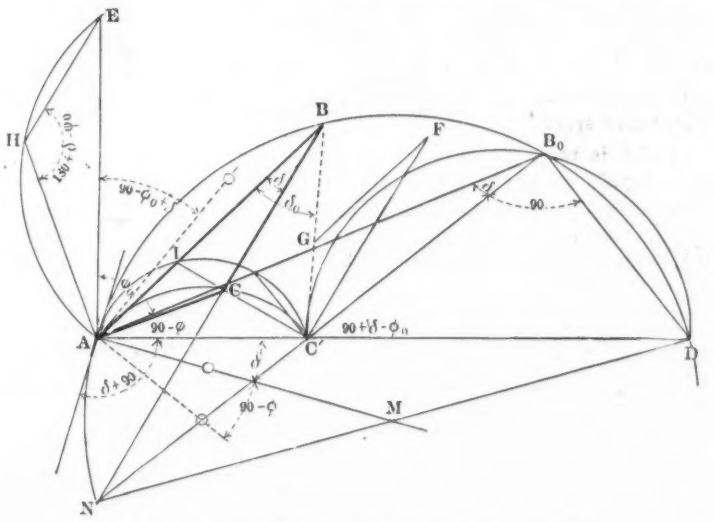


FIG. 2.—COMPLETE PERFORMANCE DIAGRAM.

angle ϕ_0, and the angle δ between primary and secondary currents can be calculated. In the present case the primary part is, of course, the rotor, and the secondary part is the stator. The point B_0, Fig. 2, is situated on the semi-circle having CD as a diameter, and

$$CD = \frac{i_0}{\sigma}; \quad \sigma = \frac{1}{v^2} - 1.$$

Its exact position depends on the primary and secondary resistance and is the same for the plain as well as for the inverted repulsion motor.

As soon as the rotor begins to revolve, the flux $\frac{i_1 Z}{\zeta_1} v_1 \sin a$, which is in quadrature with the line of the direction of the brushes, induces in the rotor an e.m.f. $HE = \frac{i_1 Z^2}{\zeta_1} \sin a \; K' \; n \; v_1$ in phase with i_1.

The impressed e.m.f., therefore, is to be considered as being composed of two components, one of which is equal and opposite to HE, and the other to AE, the e.m.f. induced in the rotor windings by the resulting flux in the direction of the brushes.

Remembering that the secondary is short-circuited and, therefore, of constant resistance, i_1 will always be in proportion to the resulting stator flux as well as to the resulting rotor flux, the latter varying with AH. This implies that as soon as AH changes, the currents will change in proportion, and, therefore, the angles of the current triangle ABC will remain constant.

From Fig. 1 we see that δ_1 is constant and equal to $180 - \phi_0 + \delta$, ϕ_0 being given from the data of the machine and δ remaining constant, owing to the above-mentioned reasons. The point H, therefore, moves on the arc $A\,H\,E$ subtended by the chord $A\,E$. The center of the circle lies on the vector drawn through A and making the angle $90 - \phi_0 + \delta$ with $E\,A$.

Since the primary magnetizing current is always in proportion and in quadrature to $A\,H$, the point C' will move on a similar arc, $A\,C'\,C$, subtended by the chord $A\,C$. And the vector $A\,B$, equal to $i_2 Z$ and always in proportion to and at a constant angle with $A\,C'$, will move also on a similar segment, $A\,B\,B^0\,D$, having $A\,B_0$ as the chord.

If we draw a tangent to the circle $A\,B_0\,D$ at the point A, it will make an angle of $180 + \delta - \phi_0$ with $A\,B_0$ and the angle $90 + \delta$ with $A\,D$.

By comparing Fig. 2 with the diagram published by Mr. Osnos in the *Electrotechnische Zeitschrift*, of October 27, 1903, it will be seen at once that the circle $A\,B\,D$ has the same tangent at the point A, and since the point B_1 is identical with the point B_0, both circles are identical.

Since the angle δ is constant in the case of the inverted repulsion motor, the angle $C\,B_0\,D$ is constant also and equal to 90°. The prolongation of $B_0\,C$ will, therefore, go through the point N.

By connecting B with C we have the triangle $A\,B\,C'$ as the current triangle of the plain repulsion motor, whilst $A\,B\,C$ represents the current triangle of the inverted repulsion motor of the same input.

From these triangles we see that at a given input and phase angle ϕ, the inverted repulsion motor has a smaller secondary current; a smaller phase angle between the primary and the secondary current; and since $I\,C'$ and $A\,C'$ are the resulting secondary and primary ampere-turns, a much smaller magnetic saturation, therefore, smaller copper and iron losses, or in other words a higher efficiency. This gain in efficiency would manifest itself at the same torque by an increase in speed.

If $G\,F$ is the e.m.f. induced by the rotation of the rotor of the plain repulsion motor, $H\,E$ is this e.m.f. in the case of the inverted repulsion motor, and we have

$$GF = \frac{A\,B_0}{\zeta_1} Z \sin \alpha\, n'\, K' \quad \text{and} \quad HE = \frac{B\,C'\,Z}{\cos \alpha\, v_1} \sin \alpha\, n''\, K'',$$

$$n' = \frac{GF\,\zeta_1}{A\,B\,Z \sin \alpha\, v_1\, K'} \quad \text{and} \quad n'' = \frac{HE \cos \alpha\, v}{B\,C' \sin \alpha\, K'\, Z}$$

where n' means the number of revolutions of the plain repulsion motor and n'' those of the inverted motor, K' being a constant.

From the above it is evident that the inverted repulsion motor is superior to the plain repulsion motor.

Of vital practical importance is the commutation of such a motor. We will, therefore, next consider the conditions governing it. To repeat a well-known fact, sparking is caused by induced e.m.f. in the short-circuited coil, which tends to maintain a current while passing under the brushes. In a direct-current motor with the brushes in the neutral position we have only the e.m.f. of self-induction, which alone is not able to disturb good commutation in a machine of modern design. In an alternating-current motor, however, the action is more complex. In addition to the self-induction, the resulting flux of the machine, being pulsating, induces an e.m.f. of considerable value in the short-circuited coil, good commutation being obtained only under certain conditions. In the case of the plain repulsion motor the resulting flux may be considered as made up of two components, one in the direction of the line of the brushes, the other in quadrature with it. The former is given by the line $I\,C'$ in the diagram, Fig. 2. The latter being coincident in time and proportional to the stator current can be represented by the line $A\,B$. The angle made by them is $C'I\,A = D\,B_0 A = \delta + 90$, and is constant. In a well-designed machine, angle δ is very small, and the time relation between the two components, therefore, differs but little from 90°. The diagram, Fig. 2, shows that with increasing speed $I'C$ increases, whilst $A\,B$ decreases, so that at a certain speed, namely, at synchronism, the two components are equal. That means that at this speed neglecting the small angle, δ, a practically perfect revolving field exists. Under those conditions the short-circuited coil has no motion relative to the resulting flux and no e.m.f. is induced. Hence, the commutation is good for all speeds not differing much from synchronism.

In the inverted repulsion motor the resulting flux may be resolved into two components having the same space relation as in the foregoing case. One component is in the direction of the line of the brushes and is represented by the line $A\,C$, Fig. 2. The other component is proportionate to and in phase with $B\,C$. The angle $A\,C\,B$ made by them is very nearly 180° and constant. But contrary to the former case the ratio between the two components is constant, no matter how the other conditions change. Consequently, there can be no revolving field, and there always will be induced an e.m.f. in the commutating coil. It follows, then, that good commutation is not to be expected in the case of the inverted repulsion motor.

The Siemens & Halske Rapid Type-Printing Telegraph.

A novel kind of rapid typeprinting telegraph is being developed and has just been brought out by the Siemens & Halske Company. The apparatus is similar to the Pollak-Variag telegraph, as the telegram is prepared on a sort of typewriter, piercing for each letter certain holes in a continuous paper ribbon (Fig. 1). The latter on

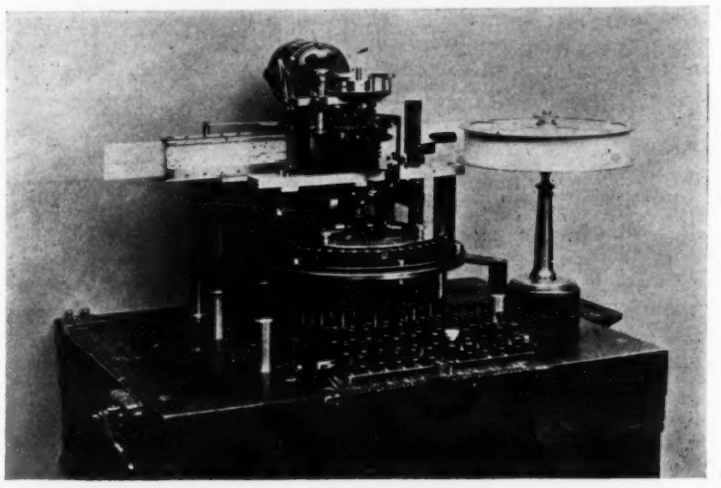


FIG. 1.—RIBBON PERFORATOR.

being drawn through the rotating telegraphic transmitter will automatically throw into the circuit corresponding current impulses. The Siemens apparatus will enable the telegrams transmitted by quite a number of officials to be sent through the same line. Two holes are pierced in the paper ribbon for each letter, the letter itself being printed in plain printing characters immediately above. The public will itself be able to do the perforating, transmitting the prepared ribbon to the telegraph office. In the receiving apparatus the ribbon arrives at the same speed, ready for sticking on telegram forms.

A disc, where the various letters are cut out as in a pattern, is rotated at a speed of 2,000 turns per minute, between a spark-gap and a continuous ribbon of photographic paper. Whenever a spark

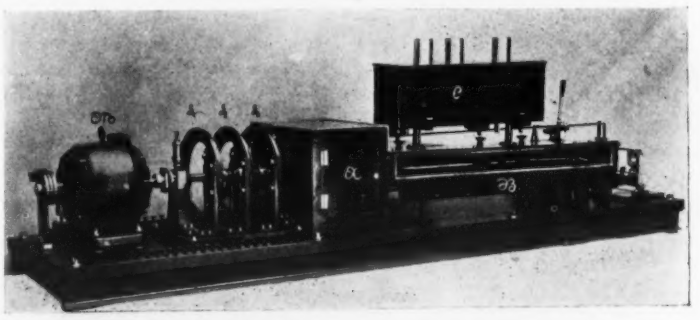


FIG. 2.—RECEIVING APPARATUS.

passes across the gap, a silhouette of the letter happening to be in front of the same is projected on the paper ribbon. It should be noted that the spark must be produced with an accuracy as high as one 40,000th part of a second, in order to have the proper letter appear at the proper place. The ribbon runs into an opaque box between sponges saturated with developing and fixing fluids, passes a simple drying arrangement and leaves the apparatus half moist with the immediately readable dispatch. The entire photographic process requires only nine seconds. The mechanism of the apparatus

has been so simplified that the receiver, apart from the photographic device, is reduced to a shaft driven by an electromotor on which, in addition to the type disc, there are mounted only some brushes sliding over contact discs. Fig. 2 gives a view of the receiving apparatus, showing at M the driving motor and at S_1, S_2, S_3 the three discs. The three boxes illustrated contain the type wheel, the photographic developing and fixing arrangement and the reservoir for the photographic fluids.

Experiments, for which the Imperial German Postal Department put at the disposal of the Siemens & Halske Company its line between Berlin and Frankfort, have shown the practicability of the apparatus for transmission over great distances, and have proved that a speed as great as 2,000 characters a minute can successfully be maintained.

Telephone Lead-Covered Cables Attacked by an Insect.

The China & Japan Telephone Company, of Shanghai, China, has had an extraordinary experience in cable trouble, caused by the attack of an insect which pierced the lead covering of its telephone cables. It was noticed several years ago that the lead sheathing of the aerial cables was perforated by holes, which admitted water and gave rise to much trouble. It was assumed that the injury was caused by small rifle bullets, and a reward of 50 taels was offered for information that would lead to the punishment of the wrongdoers. Later it was established that the holes were the work of wasps of a species that lays its eggs in the living bamboo. These wasps gather around bamboo groves in July and August to lay their eggs inside of the cane, where they will be well protected from attacks of hungry enemies. The cables were never attacked any distance away from bamboos. As immediate protection linseed oil boiled to the consistency of birdlime was used, and later all cables in the localities where damage had been done were covered with hemp cloth so as to present a soft surface which the insects do not attack. The accompanying illustrations are from photographs of injured cables and show that the insects made several attempts before they succeeded in biting through the sheathing.

The original Shanghai telephone exchange commenced operations in 1882, but gave a service so defective that in 1900 the town council revoked its franchise, at which time there were only 360 subscribers.

FIG. 2.—IRON TERMINAL POLE, SHANGHAI.

FIG. 1.—SECTIONS OF LEAD-COVERED TELEPHONE CABLES DAMAGED BY INSECTS.

Several organizations competed for the franchise, which was finally awarded to the Shanghai Mutual Telephone Company. This company, under the management of Mr. Gustaf L. Oberg commenced operations with 100 subscribers four months after the former company had removed its poles. Nine months later, in 1901, it had 418 telephones; in 1902, 619; in 1903, 916, and at present there are 1,500 subscribers. The number of present subscribers might have been larger had it not been for the difficulty of training native workmen employed on construction as well as native operators for the exchange.

Several years ago we illustrated the exchange as first installed for 600 subscribers. At present it is equipped for 2,500 subscribers. When the photograph from which Fig. 4 is reproduced was taken, there were 12 operators at work. The Chinese superintendent is standing behind the operators and two foreign women superintendents are sitting at their respective tables. The illustration of

the underground construction (Fig. 3) was taken a mile from the exchange. Fig. 2 shows an iron pole where underground cables terminate. The upper poles, which are made in Shanghai, are of 2-in. angle iron and joined to a shaft pole which has previously been set in concrete. The joint is afterward covered with concrete to 18 in. from the ground to protect it from water and dirt. These poles are light and inexpensive and if kept well painted will last a long time.

In Shanghai, when a section of a telephone cable gets wet, it is

FIG. 3.—UNDERGROUND CONSTRUCTION, SHANGHAI.

not cut out and replaced by a new section, but dried out, by pumping dry air into it. This has been found a satisfactory and economical method and also expeditious, especially in wet weather, when splicing cannot be done.

Mr. Gustaf L. Oberg, director and general manager of the Shanghai exchange, recently paid a visit to this country to learn about new telephonic developments, as it is proposed to increase the Shanghai plant to a capacity of 5,000 subscribers. It is also intended next year to commence a new exchange building with an ultimate capacity for 30,000 subscribers. While here Mr. Oberg visited a number of telephone exchanges on his way from San Francisco to New York, and everywhere, he says, was received by telephone men, when they learned his business, with the kindest courtesy and good will. The inner workings of the exchanges, with original reports from heads of departments, were freely shown, indicating that in this country the profession has nothing to conceal. He found it a source of great and lasting pleasure to meet everywhere men who are so entirely devoted to their profession and so free from petty jealousies that they are willing to sacrifice their time to help others. He no longer wonders at the rapid progress telephony has made in this country.

FIG. 4.—SWITCHBOARD, SHANGHAI EXCHANGE.

Municipal Lighting of Buenos Ayres.

The public lighting in the city of Buenos Ayres during 1903, according to the monthly bulletin of the International Bureau of the American Republics, was effected by means of 13,761 gas lamps, of which 5,292 were incandescent, the cost being $1,064,543 (national currency), the price per lamp being $6.50 per month for the ordinary lamps, as well as for the incandescent. There were also 2,866 kerosene lamps, costing $217,510. The three gas companies had 70,063 meters fixed in houses, as against 66,159 in 1902, the gas consumed by the private subscribers being 26,845,430 cu. meters, as against 25,017,231 in 1902. The income from this source was $5,708,673 (national currency).

The various companies supplying the gas, and the number of subscribers respectively supplied, were as follows: River Platte Gas Company, 29,542 subscribers, 11,430,520 cu. meters; Primitiva Gas, 22,959 subscribers, 9,064,556 cu. meters, and the New Gas Company, having 17,562 subscribers, and furnishing to them 6,350,354 cu. meters. The gas and electric light companies have 681½ km. of mains, and the electric tramways 63¾ km.

The electric returns for the municipal stations, comprising 387 arc lamps and 808 incandescent lamps, show a consumption of 510,957 kw., costing $118,895 (national currency). The public lighting by supply companies was: Primitiva Gas, 78 arcs of 15 amp., and the Compañí Alemaña Transatlantica de Electricidad, 612 arcs of 10 amp. and 10 incandescents. The cost of the service was: Primitiva, 381,880 kw, with a cost of $30,962, and the Alemaña, 1,221,341 kw, costing $159,091, a total of 1,603,221 kw and $190,053.

The free lighting given by the electric tramway companies, in accordance with the terms of their contracts, comprised 1,165 lamps of 16 cp. The two stations at the docks belonging to the National Government had 458 arc lamps, the cost amounting to $57,174 gold, the cost per kw-hour being 8¼ cents gold. The private electric light service comprised 7,608 consumers, with an equivalent of 254,032 incandescent lamps of 16 cp, the cost per kw-hour being: Light, 17 cents gold, and power, 7.81 cents. The current supplied was: For light, 7,384,689 kw; for power, 2,351,275 kw, and for tramways, 20,049,638 kw. The total supply of electric current for all purposes during the year was 32,590,907 kw-hours.

The Rochefort System of Wireless Telegraphy.

BY A. FREDERICK COLLINS.

DURING the past few years a great deal of attention has been given to the action of self-induction and electrostatic capacity on oscillations of high frequency and the relation of these coefficients to resonance phenomena. A French patent was issued to Dr. Oudin on February 21, 1900, for a bi-polar resonator, and although this and his earlier type of unipolar resonator were designed by him primarily for electrotherapeutics, it is also applicable to wireless telegraphy.

In the single-pole resonator (Fig. 1) two condensers, preferably

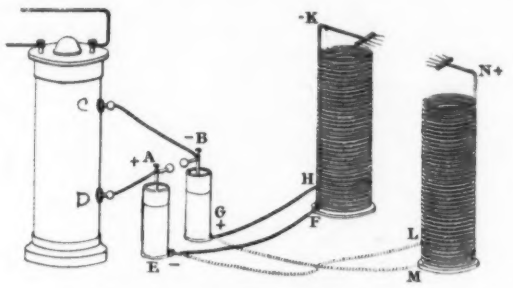


FIG. 1.—SINGLE-POLE RESONATOR.

Leyden jars, have their inner coatings connected to conducting rods terminating in metal spheres forming the spark-gap. From these rods, *A, B,* wires lead to the secondary terminals, *C, D,* of an induction coil or other source of high-tension current. The outer coating, *E,* of the Leyden jar is joined to one end of a spiral of wire forming the inductance coil at *F,* and the outer coating of the opposite and complementary jar is connected to a point, wherever desired, as for instance, at *H* on the solenoid.

To charge the Leyden jars the spark-gap spheres are caused to approach each other until their potential difference is sufficiently great to disrupt the air which insulates them, when the oscillatory discharge takes place. The oscillations thus set up in the system are synchronous with the sparks of discharge, and as these surge through the circuit, of which *F, H,* of the inductive coil forms a part, as well as the external coatings of the jars, an oscillating field of force will result at the terminal, *K,* of the coil. This field of force produced by the oscillations will be a maximum with a given expenditure of energy when the value of induction represented by the turns of wire between *F* and *H* are properly selected.

This "point of insertion" as Rochefort terms the completion of the

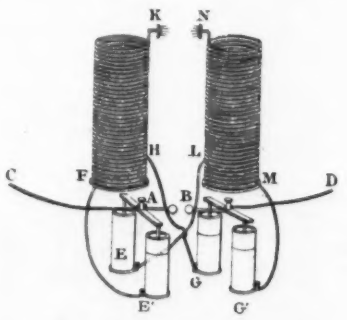


FIG. 2.—TWO RESONATORS.

circuit at *H,* varies with the capacities of the jars and the number of turns on the induction coil; it is, however, independent of the length of the spark-gap and the potential of the discharge current. A characteristic discharge is produced at *K* when an Oudin unipolar is used, forming a brush and extending a distance of 10 or 12 cm.

The considerations leading to a double resonator may be the better understood if we examine closely the case of a discharge of a certain sign is produced at *K.* Let us suppose that the potential difference between the spheres of the spark-gap is just ready to disrupt the film of air separating them, and that the jar, *A,* is charged to the positive sign and *B* to the negative sign, when it must follow that the external coating, *E,* will be negative, and that of *G* positive.

When the spark passes the current flow in that position of the circuit indicated by *H, F,* of the induction coil will be in the direction of *G H E F.* A current will now be instantly induced in the opposite direction in that portion of the coil designated by *H, K,* which will have its maximum tension and negative potential at the terminal, *K.* In virtue of the oscillatory nature of the disruptive discharge, the succeeding air-spark will reverse the signs and produce a positive field of force at *K,* and the discharge at *K* will be converted from positive to negative and from negative to positive in accordance with the direction of the sparks through the air-gap.

A second induction coil, *L M H,* may now be placed in close proximity and parallel with the first coil, and its lower terminal, *M,* and point of insertion, *L,* likewise connected to *E G;* in this case when the disruptive discharge takes place high-potential charges of the opposite signs, which attract each other, will be produced at *H* and *K;* or if *E* is connected to *M* and *G* to *L,* then discharges of the same sign will be obtained at *N* and *K,* and these will repel each other. In practice, however, we are informed by Rochefort it is very difficult to adjust the inductance of the two coils, and this untoward condition may serve as a hint to those who have had trouble in tuning commercial systems.

For this reason the capacity of at least one of the jars or condensers should be made variable, so that an absolute value may be more easily arrived at. In order that the two portions of the resonance apparatus may be made adjustable within certain limits, the capacity of the system may be made up of four or more jars with their interior coatings connected in duplicate, as shown in Fig. 2. Two complete resonators are thus controlled by a single spark-gap, but still operating independently of each other, since their primary circuits are separate and distinct.

This arrangement is found to give very satisfactory results, and is the one employed by Dr. Oudin in the treatment of diseases, and by Prof. Rochefort in his system of wireless telegraphy. Double polarity may be obtained by connecting the inductance coils at the points, *F* and *M,* and connecting *H* to *G* and *F* to *L* as in Fig. 3;

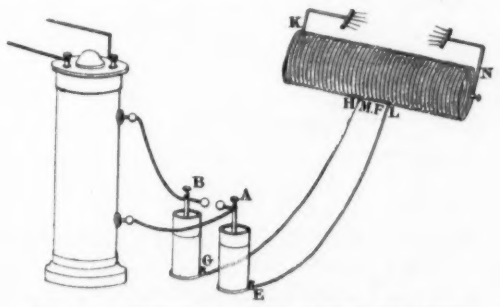


FIG. 3.—CONNECTIONS FOR DOUBLE POLARITY.

these may be superposed or made to form a single coil, the middle portion, *H L,* of which is used as a primary. This latter arrangement, it was found, has the same disadvantage as that shown in Fig. 1, namely, that of making the two coils interdependent.

In the Rochefort apparatus proper for telegraphing without wires, the emitter includes (1) a source of e.m.f.; (2) a transformer of the induction coil type; (3) a Hertz oscillator; (4) a radiating aerial wire, and (5) a wire leading to earth. As in other systems, the aerial wire and earthed conductor are also used with the receiving apparatus, a switch being employed in changing from one to the other.

By referring to Fig. 4 the general arrangement of the transmitter is shown in perspective. The source of current, *A,* is usually a storage battery. One of the terminals of this is connected direct to one end of the primary winding of the induction coil, *D,* through an aperiodic ammeter. The opposite terminal of the battery leads to the primary of the coil through a key, *M,* thence through a reciprocating interrupter, *B,* which is operated by an independent current; finally, a condenser, *C,* is shunted around the break, *B,* and may be adjusted until the optimum capacity is found. The secondary terminals, *G, I,* of the induction coil, lead to the earth and aerial wire, respectively in a non-syntonic system; or where resonance effects are desired, either simple or sympathetic, the aerial and earth wires may be connected to the terminals, *K, M,* of the induction coil, Fig. 2.

The storage battery employed, *A,* comprises twelve cells, giving 6 to 9 amp. and 24 volts, and has a capacity of 100 amp.-hours. A continuous-current dynamo may, of course, be substituted for the battery provided the primary of the coil is wound for the increased voltage, and any excess of current may be cut down by means of a rheostat.

A key, or manipulator, *M*, as the French term it, of special design is designed to produce Morse characters. It consists of a vertical rod, the upper end terminating in an ebonite button, while the lower end is made of platinum. This rod forms one terminal of the primary circuit. Immediately under the rod there is a cup of mercury which forms the opposite terminal of the circuit. When the rod is depressed the platinum point forms a contact with the mercury and the primary circuit is then closed. When the pressure on the rod is relaxed a spiral spring forces it away from the mercury, breaking the contact. A layer of petroleum is usually placed on the surface of the mercury, which contributes largely to the reduction of the spark, and a current of 9 or 10 amp. may be broken with safety.

The interrupter, *B*, is of the reciprocating mercurial type. It is constructed on the same general principles as the key; that is, a reciprocating rod makes and breaks the circuit in a cup of mercury; but instead of the action of the rod being arbitrarily manipulated by the telegrapher, it is automatically operated by an electromagnet energized by a couple of cells, as shown in Fig. 4. The condenser,

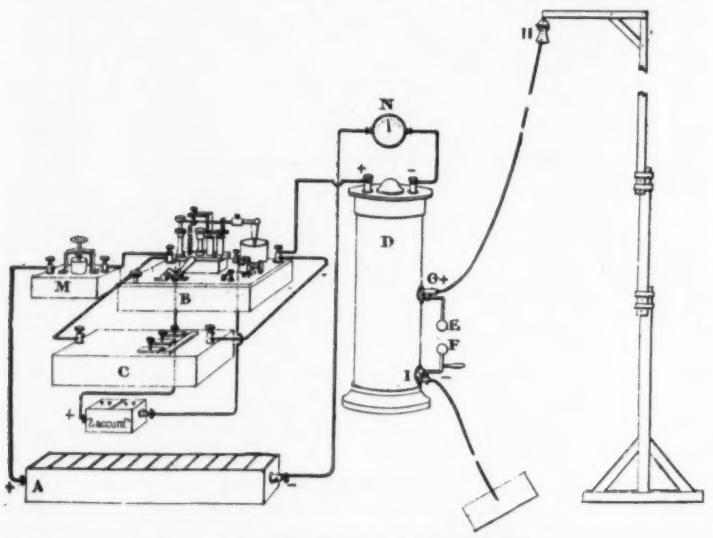


FIG. 4.—ARRANGEMENT OF TRANSMITTER.

C, is of the standard mica and tin-foil type and may be adjusted to suit the needs of the current employed.

The induction coil designed by Rochefort is of the vertical type and the model shown is especially applicable to the requirements of wireless telegraphy, in that the potential energy developed at the terminals of the secondary coil is unipolar. In order to produce this result the secondary is formed of a double winding of the wire, so that it returns and reunites at the pole from which it starts. By this method of double winding the potential at the terminals is dissymmetrical, and while the tension in the center of the coil is negligible, it is accentuated at the poles. The pole of the negative sign is connected with the conductor leading to earth, and the positive pole to the radiating wire. This form of construction has been made the subject of letters patent by the designer of this system in France.

In the Hertz oscillator, *E F*, the spheres of the spark-gap are 2 cm in diameter and are adjustable, so that any length of spark may be obtained within the working limits of the coil.

The aerial wire, *G H*, is suspended by a special form of insulator made of hard rubber and having a length of 50 cm. and a diameter of 2 cm., and is encased in porcelain. From this interior of the insulator a gutta-percha covered cable is attached having a diameter of 8 mm., and formed of five or six wires. The extreme base of the aerial wire is joined to one pole of the spark-gap of the induction coil. The upper extremity is held in place by connecting the insulator to the yard arm of a mast.

The opposite pole of the spark-gap is attached to a large metal plate or plates through the medium of a wire. The plate is buried in the earth, preferably where there is considerable moisture. Rochefort points out the necessity of having a "good earth" if messages are to be transmitted over considerable distances. The wire leading to the plate should be thoroughly insulated and care should be taken that it does not come in contact with any portion of the building in which the instrument is placed. Glass or porcelain insulators should be used for this purpose.

The function of the apparatus for transmitting Morse signals will be clearly understood by referring to Fig. 4. First the interrupter is set in motion and then the spheres of the spark-gap are drawn toward each other until separated only by 5 or 10 mm. The button of the key may then be manipulated in accordance with the telegraphic code. The time of contact will determine the number of effective makes and breaks of the mercury interrupter, and on this will depend in turn the number of discharges through the gap, and, therefore, the number of oscillations. The best results are obtained when the interrupter is making from 24 to 30 breaks per second. The discharge is composed of a number of sparks ranging from 10 to 50 and is practically instantaneous; the oscillations in the circuit and the waves emitted will depend on the contact of the key.

The features of the receiving apparatus will now be considered. The Rochefort receiving device comprehends, as the schematic drawing, Fig. 5, will show, (1) a receiving antenna, *H G;* (2) a conductor leading from the coherer to the earth; (3) a telegraph relay, *A B*, connected to the coherer through a local cell, *P;* (4) a coherer

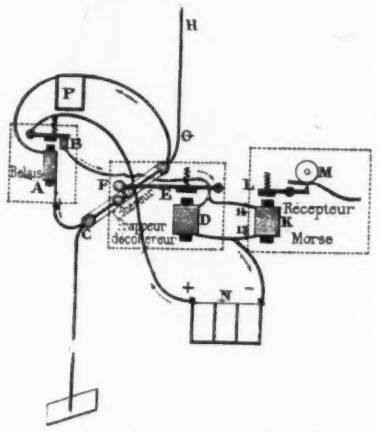


FIG. 5.—ROCHEFORT RECEIVER.

of the Rochefort or Tissot type, *C G;* (5) an electromagnetic decoherer, *D E F*, a Morse register of the ordinary type, *K L M*, and a tapper or decoherer, *D K*. The electromagnets, *D K*, of the tapper and Morse register are coupled in parallel with a branch circuit leading to a local source of current, and the contact points of the relay renders them operative when the coherer actuates the relay magnets. The connections of the Rochefort receiver are more clearly indicated in the side elevation, Fig. 6, and the plan view, Fig. 7.

The same aerial cable serves in the dual capacity as antenna and radiator, a switch connecting it first with the coherer and then with

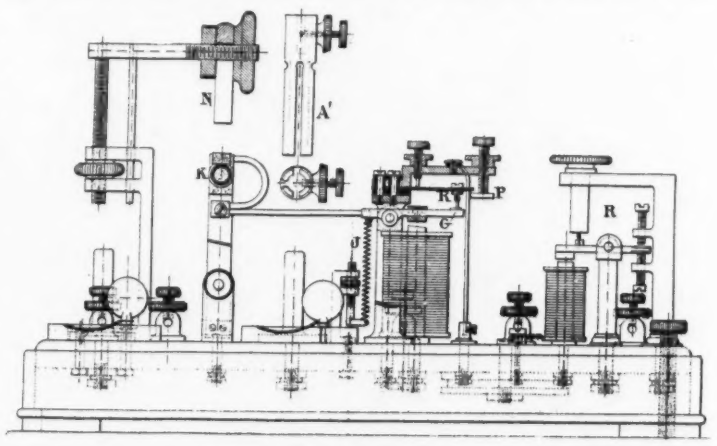


FIG. 6.—ROCHEFORT RECEIVER.

the spark-gap, as desired. The lower terminal is connected to the receiving apparatus by means of a binding post, *A*, and is interchangeable with the post, *F* (Fig. 4) of the induction coil through the switch just mentioned.

The same earthed terminal used in sending signals is employed in receiving messages, and is connected to the binding post, *T* (Figs. 5, 6 and 7) of the receiver. The double-throw, double-pole switch for changing the aerial wire also makes the change of the earth wire from the transmitter to the receiver.

The relay device shown in the illustration is a relay of the ordinary type except that it is vertically arranged and its coils are wound to 1,000 ohms resistance. Rochefort says that where long distances are to be covered it is better to use a Claude polarized relay.

A coherer of proper design is of prime importance in the construction of a sensitive receiver, and since the coherer was invented by Rochefort's compatriot, Branly, considerable attention has been given to this portion of the apparatus. In Rochefort's system two types have been employed, one designed by Tissot and the other, which is magnetic in action, by the inventor. The coherer of Tissot, Fig. 9, is composed of two electrodes 3 to 5 mm. in diameter. These elec-

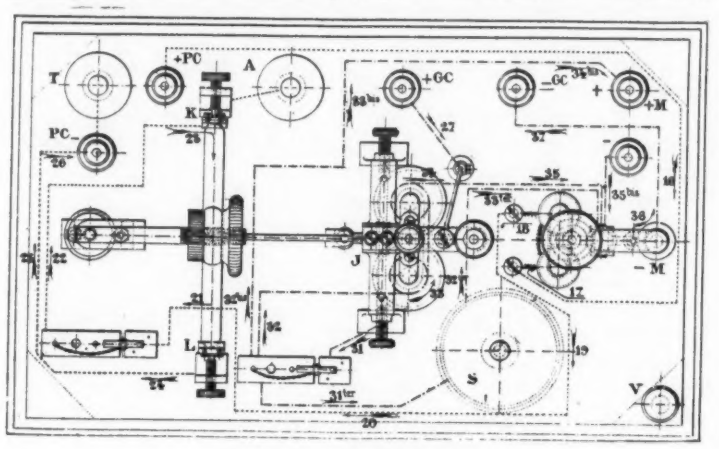


FIG. 7.—ROCHEFORT RECEIVER.

trodes have beveled ends forming a V-shaped pocket similar to that employed in the Marconi and Slaby-Arco systems. These conductor plugs have wires leading through the ends of the tube, where they connect with metal caps as in a Geissler tube. A nipple is blown on the side of the tube and this is filled with carburet of calcium for the purpose of taking up any moisture which may remain in the tube.

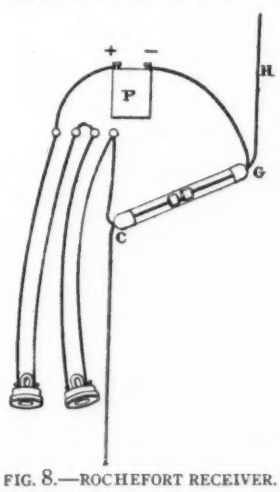


FIG. 8.—ROCHEFORT RECEIVER.

The second coherer, Fig. 10, has also the inevitable dual conductor plugs, but in this case they comprise little concentric soft-iron cylinders having interiors of ebonite or glass. In the cut the soft-iron cylinder to the left is shown connected to one of the leading-in wires, while the leading-in wire to the right is connected to a copper rod of small diameter forced through the centers of both insulators inside the soft cylinders and thus forming an annular space for the filings, which are also of soft iron. The leading-in wires are sealed in the ends of the tube and are connected to metal caps fastened to the exterior ends of the tube, as previously described. A little bag of carburet of calcium is enclosed in one end of the tube to take up any excess of moisture. A steel horseshoe magnet, shown in Fig. 6, is arranged so that the coherer lies in the magnetic field, and when the oscillations cause the filings to cohere, the action is strengthened by the magnetic lines.

In Figs. 6 and 7 the electromagnetic decoherer is shown. The current from the local battery, *N*, Fig. 5, passes through the electro-

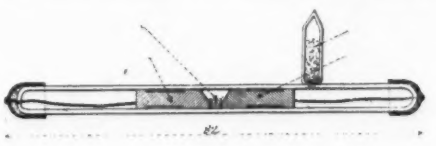


FIG. 9.—TISSOT COHERER.

magnet coils when hey attract the armature carrying the tapper, causing it to strike the tube, when the local relay circuit of which the coherer forms a part, is broken. The Morse receiver, *K L M*, is of the ordinary type and has been frequently described in these columns in connection with other systems.

The filings of a coherer present a variable resistance depending on the dimensions of the electrodes, the amount of filings, etc. When the resistance of the filings, which let us say is 15,000 ohms, is reduced to, say, 1,000 ohms by the oscillatory current set up by the impinging waves, the current from the local cell, *B* (Fig. 5), operates the relay and draws the movable point into contact with the stationary point, *B;* this closes the second local circuit in which is included the tapper and register and they respond in consequence. Where an autodecoherer is employed the Rochefort receiver takes the form shown in Fig. 8. The plugs of the autodecoherer are connected with the aerial and earth, respectively. A local circuit is formed by the tube, a pair of head telephones and a primary cell. Rochefort sug-

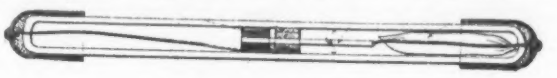


FIG. 10.—TISSOT COHERER.

gests that the Hughes, Mengachwender or Schafer autodecoherers as suitable for use with telephone receivers.

The work of extending the wireless telegraph service is going on very rapidly in France at the present time and the honors are pretty evenly divided between the Branly, Rochefort and Tissot systems.

English Municipal Plants.

In his address as president of the Incorporated Municipal Electrical Association of England, Mr. T. P. Wilmshurst, borough electrical engineer of Derby, said: "When our first president, Mr. Arthur Wright, addressed you, he referred to the fact that our members controlled undertakings with a capital outlay amounting to £4,000,000. Within eight short years this has risen to £25,000,000, and including the tramway undertakings with which many of us are connected, it may be safely said that our members control an industry with a capital of nearly £40,000,000."

Mr. Wilmshurst discussed various topics and recommended (1) the periodical renewal of consumers' lamps, free, or on easy terms; (2) the periodical inspection of consumers' lamps *in situ*, or (3) the free testing of and reporting on consumers' lamps. With regard to rates and business, he said:

"We are handicapped in the pushing of our business by the fact that our capital charges are so heavy as compared with our revenue. This is, I believe, largely due to the want of a cheaper and more efficient method of storage. As a matter of fact, the average percentage of our revenue to capital only amounts to 10 per cent., as compared with 24 per cent. of gas undertakings. It is a sign of promise for the future, however, that the increasing use of power during the hours of daylight is helping toward the solution of the problem of this small percentage. This, however, should be sold at the lowest possible price, and if necessary encouraged by letting out the motors on hire. The progress of power supply in many of our towns is so marked that I believe it is having and will have a distinct influence in those towns which wish to retain old and attract new industries. Just as in foreign countries we find new and thriving trades settling round the sources of cheap water power, so I believe the best industrial inducement we can offer to the manufacturers to settle within our boundaries will be the offer of cheap electric power.

"In our own town of Derby the progress of power supply has been most encouraging. Five years ago we gave a supply to 20 motors aggregating 70 kw. At the present time we have a total of 250 motors aggregating 1,300 kw connected to our single-phase mains, while the percentage of units sold for power to total units sold amounts to 30 per cent. Allied to the foregoing is the vexed question of the proper apportionment of charges for energy for tramways between the two committees interested. Many members of tramways committees, who have usually not had the opportunity of studying the considerations which underlie the costs of production, fail to see why they should be asked to pay say 1½d. to 2d. per unit, while smaller consumers of energy for industrial purposes only pay, say, 1d. to 1½d. per unit. A little consideration shows that there are at least two good reasons why this is so. The cost of producing electrical energy is independent of the purpose to which that energy is applied, and it depends chiefly on the rate of production; in other words, on the load factor. Now, experience shows, contrary perhaps to what one would expect, that as a rule a motor load has a higher load factor than a tramway load.

"The second consideration is that in the case of the traction supply the energy must be taken from a separate plant to that supplying the lighting, and also a separate and distinct switchgear and set of mains must be provided, whereas the motor load is taken from the same machinery and mains as is supplying the lighting. For towns of moderate size I look to the battery and reversible booster as an important factor in reducing tramway costs."

Some Tests of Iron and Woodworking Machinery.

By C. H. Hines.

THE following tests were made by me to determine the amount of power used by old machine tools in a shop which we propose to equip with electricity and yet retain a large portion of the old machines; and to that end in many cases we used the modern tool steel on the old machines to determine the limit to which they could be worked.

Many articles have appeared from time to time in the electrical and railroad journals giving different tests, but the results attained did not at all satisfy me, as they in most cases applied to direct-driven new tools, and in some cases I am afraid were shaded to give an impression that tools required little or no power to drive them. This has also been the case in taking load factors or the per cent. of tools in use at one time, and some of the figures given have been proven to be far too low.

The following tests were made with a Bullock multi-voltage set, with balancer and all complete. The method of operating was to locate the generator and balancer centrally in the shop to be tested; the motor and controller were mounted on a substantial truck with cast-iron wheels, and moved from tool to tool, being fastened securely on each occasion. The instruments used were of Weston make and carefully calibrated.

METAL-WORKING MACHINERY.

The motor used in these tests was of the multipolar type, 220 volts, 600 r.p.m., 12½ hp, 10-in. pulley on motor, multipolar voltage speed controller, standard voltages 44, 66, 110, 140, 184, 250 volts. The motor running light consumed ⅓ hp.

Bertram Wheel Lathe, 84 in.

R.p.m. of countershaft, 140; turning Krupp tires on 58-in. driving wheels; cutting speed of machine, 9 ft. 1 in., 13 ft. 9 in. 15 ft. 4 in., 15 ft. 6 in., 17 ft. 0 in. per minute; tool steel, "Novo"; depth of cut, 5/16 in. for each tool; feed, ⅛ in.

Lathe running light	¾ hp,		
Light load 2¾	"	cutting speed of machine	9 ft. 1 in. per min.
Medium load...5.6	"	"	13 ft. 9 in. per min.
Medium load...7.25	"	"	15 ft. 4 in. per min.
Medium load...9.5	"	"	15 ft. 6 in. per min.
Heaviest load..12.0	"	"	17 ft. 0 in. per min.

Bertram Double-Headed Slotter.

R.p.m. of countershaft, 160; size of machine, 30 in. x 14 ft. 0 in. bed x 10 in. stroke; slotting outside of front end of two main rods, best hammered iron. Each head on downward stroke traveled 7 in., 12 strokes per min., cutting 4 in. each stroke. Depth of cut, ¼ in.; feed, 1/16 in.; tool steel, "Novo."

Machine running light.....1.34	hp	
One head.....2.64	"	to 4.55 hp
Two heads.....2.15	"	to 4.35 "
Maximum load.....4.5	"	

Craven Wheel-Boring Mill, 84-in. Swing, with 3 Tool Rests.

Revolutions of countershaft, 76; facing hub; cutting outside diameter, 63 in.; cast-steel driving wheel center; truing width of center; cutting speed of machine, 23 ft., 24 ft., 25 ft. per min.; facing tool, depth of cut, ⅛ in.; feed, 1/16 in.; outside tools, depth of cut, 7/16 in.; feed, 3/32 in.; tool steel, center head "Mushet," outside heads, "Novo." At a cutting speed of 26 ft. per min. the machine table lifted and broke the "Mushet" tool.

Mill running light .....¾	hp				
Light load, center tool cutting 4¼	to	6.0	hp	cutting speed	23 ft. per min.
Medium load, center and one side tool cutting...6.4	"	8½	"	"	24 ft. per min.
Heavy load, center and two side tools cutting.12¾	"	17.1	"	"	25 ft. per min.
Max. load developed 17.1	"				

Craven 30-in. Chuck Lathe.

R.p.m. of countershaft, 64; size of machine, 30 in. swing with two tool rests; turning 27¾-in. cast-steel dome ring to 27¼ in.; depth of cut, one tool cut ⅛ in., one tool cut 3/32 in.; feed, 1/16 in.; cutting speed of machine per min. 26 ft., 28 ft., 44 ft., 46 ft.; tool steel, "Novo."

Machine running light..... ½	hp		
Light load 2.68	"	cutting speed	26 ft. per min.
Medium load 3.5	"	"	28 ft. per min.
Heavy load 6.7	"	"	44 ft. per min.
Heavy load 7.0	"	"	46 ft. per min.
Maximum load developed.....7.4	"		

Bertram 36-in. Triple-Geared Extension Lathe.

R.p.m. of countershaft, 70 and 100, two speeds; size of machine, 36-in. and 72-in. swing, 10 ft. 0 in. bed; turning 34-in. cast-steel piston head to 33 in.; depth of cut, ¼ in.; feed, 1/16 in.; cutting speed per min., 36 ft. maximum; tool steel, "Novo."

Machine running light..... ¾	hp		
Light load 2.15	"	cutting speed	17 ft. per min.
Medium load 4.3	"	"	10 ft. per min.
Medium load 4.8	"	"	20 ft. per min.
Medium load 5.9	"	"	22 ft. per min.
Heavy load 8.0	"	"	36 ft. per min.
Maximum load developed.....8.0	"		

Note.—Took 3 min. to run cut ⅞ in. wide.

Bertram Four-Headed Frame Planer.

R.p.m. of countershaft, 170; size of machine, 5 ft. x 5 ft. x 25 ft. table, 2 crossheads, 2 side heads; planing sides of two splice frames, best hammered iron; both tools cutting 19 ft. 6 in. per min.; depth of cut, 5/16 in.; feed, 3/32 in.; tool steel, "Novo." Motor stalled cutting 20 ft. per min., 5/32-in. feed, cut ⅜ in. deep. Ratio of reversing speed to cutting speed, 2½ to 1; reverse forward required, 9.38 hp; reverse backward required, 15 hp.

Machine running light..... 3.75	hp			
Light load, one side cutting. 7.1	"	cutting speed	19 ft. per min.	
Medium load, two sides cutting 10.3	"	"	19 ft. per min.	
Heavy load, two sides cutting 13.5	"	"	19 ft. 6 in. per min.	
Maximum load developed..13.5	"			

Emery Wheel.

R.p.m. of emery wheels, 1,050; double emery wheels 19 in. diameter, 2 in. face.; grinding pieces of wrought iron 1 in. thick across full face of wheel; wheel driven direct from motor.

Machine running light..... 1.5	hp	
Medium load 7.75	"	grinding on one wheel.
Heavy load 11.50	"	" both wheels.
Maximum load developed.....11.5	"	

Bertram "Bulldozer"

R.p.m. of fly-wheel, 220; forming frog clamps, ⅞ boiler plate, 18 in. long x 19 in. wide; machine geared for 40-hp clutch; head makes 6 strokes per min., traveling 29 in. each stroke.

Machine running light..... 2.35 hp
Forming clamps took.....26.6 hp to 60 hp.

The power required to form clamps depends upon heat of plate.

Hulser Single-Spindle Radial Drill.

Size of machine, 6 ft.; r.p.m. of countershaft, 180; drilling 3 15/16-in. hole in end of side rod, best hammered iron; hole 1¾ in. diameter, previously drilled as guide for cutter bar; cutter bar 1¾ in. diameter; cast-steel cutter; feed, 1/160 of an inch per revolution of cutter.

Machine running light..... ½	hp.	
Light load 1.9	"	17 r.p.m. of drill.
Medium load 2.9	"	17 r.p.m. of drill.
Heavy load 3.85	"	23 r.p.m. of drill.
Maximum load developed.....3.85	"	

Bertram Rail-Bending Machine.

Fly-wheel, 3½ in. face x 30 in. diameter, 230 r.p.m.; bending 80-pound rail 15 ft. 0 in. long, 2 bends on top ⅜ in. in 6 ft., 1 bend on side 1¼ in. in 6 ft.; average three blows to each bend on top, average six blows to each bend on side; head travels 4-in. and 32-in. strokes per min.

Machine running light... 1	hp.	
Loaded 15	"	to 24 hp.
Average 19½	"	
Maximum load developed.24	"	

Bertram Double-Headed Frog Planer.

Size of machine, 1 ft. x 4 ft. x 32 ft. table; r.p.m. of countershaft, 400; planing the side of two 80-pound steel rails used for split switch, width of cut 1⅛ in.; feed, 1/16 in.; length of work planed, 6 ft.; cutting speed of machine per minute, 11 ft.; tool steel, "Novo."

Machine running light.... 3½	hp.	
Loaded 16¾	"	
Maximum hp developed...18	"	

Planing top of two 80-pound steel rails same feed as above, but cut 22 in. wide.

Average load .....23½ hp.
Maximum hp developed...25¾ "

Ratio of reversing speed to cutting speed, 2.68 to 1; reversing forward required, 33½ hp; reversing backward required, 40 hp.

Howton Cold-Rail Sawing Machine.

Size of saw, 38 in. diameter x ¼ in. thick; r.p.m. of countershaft, 330; speed of saw on circumference, 56 ft. per min.; r.p.m. of saw, 10½; saw made of cast steel; sawing five 56-pound rails.

Machine running light.1¾ hp.
Sawing .....3 "
Maximum hp developed.3 "

Sharp & Seward Planer.

Size of machine, 5 ft. x 5 ft. x 8 ft., 2 side heads, 2 rail heads; r.p.m. of countershaft, 100; planing center casting for engine truck, cast iron; depth of cut, 5/16 in.; feed, 3/32 in.; cutting speed of machine, 12 in., 8 strokes per min.; tool steel, one tool "Mushet," one "Novo."

Machine running light.... ¾ hp.
Cutting 1 head.....1.3 "
Cutting 2 heads.....2.15 "
Maximum hp developed..2.15 "

Ratio of reverse to cutting speed, 2 to 1; reverse forward required, 5.3 hp; reverse back required, 10.7 hp.

Bertram Engine Lathe.

Size of machine, 32-in. swing; r.p.m. of countershaft, 160; turning crank pin (mild steel) 5⅜-in. rough, 4 13/16-in. finished; depth of cut, 9/32 in.; feed, 1/10 in.; cutting speed per min., 28 ft. on medium load, 40 ft. on heaviest load; tool steel, "Novo."

Machine running light..... 3 hp.
Medium load ..... 8½ " cutting speed 28 ft. per min.
Heavy load .....17 " " 40 ft. per min.
Maximum hp developed.....17 "

Wood-Working Machinery.

Motor used in these tests, 50 hp, 250 volts, multipolar shunt-wound, 1,050 r.p.m. Motor running light, 5 amp., 260 volts, or 1.7 hp.

Royal 48-in. Invincible Sander.

R.p.m. of sanding drums, light, 1,280 and 1,225.

Sander running light.....14.7 hp.
Starting load .....80.2 "
Light load, sanding poplar ⅞ x 14 in. wide..35.1 "
Medium load, " 1¾ x 14 in. wide..46.5 "
Heavy load, " ⅞ x 47 in. wide..53.3 "
Maximum hp developed.....55.7 "

Fay Four-Headed Dimensions Planer.

Voltage of motor, 250 r.p.m.....1,050
Starting load .....83 hp.
Motor running light .....1.6 "
Machine " .....17 "
Light load, 4¾ x 5½-in. stock, rough finished to 4¼ x 5-in. 32.5 hp.
Med. load, 5½ x 9½-in. " 4½ x 9-in. 49.4 "
Heavy load, 10 x 15 -in. " 10 x 14-in. 63.3 "
Maximum load developed .....67 "

Bertram Horizontal Tenoner.

Stock used, green oak, 1 11/16 in. cut by top knives, and 2 3/16 in. by bottom knives, tenon being 1¼ in x 2 3/16 in. on one end; tenon cut on heavy load 1¼ in. x 3¾ in.

Starting load .....23 hp.
Machine running light.... 6.6 "
Loaded, medium .....13.3 "
Loaded, heavy .....16 "
Maximum hp developed...16 "

Cant & Gourley Matcher, Four-Headed.

Green oak, 3¼ in. to 3½ in. thick and 11½ in. to 12 in. wide, finished to 3 in. x 11 in. The load varied according to the crowding of material through machine.

Starting load .....60 hp.
Machine, light .....13.3 "
Loaded, varied ...39 " to 51.6 hp.
Maximum load ....52.6 "

Bertram Matcher.

Timber used, 1-in. x 6-in. red pine, rough, finished to ¾ x 5⅞ T. & G.; 1-in. x 8-in. red pine, rough, finished to ¾ x 7⅞ T. & G. Load on this work varied from 20 hp to 26.6 hp.

Starting load of machine....30 hp.
Machine running light.....10 "

Daniel Planer.

White ash, 1½ in. x 12 in. wide, finished 1⅜ in. thick, 15 hp to 21.6 hp; the load depending on how the material was crowded into the planer.

Starting load .....26.6 hp.
Machine running light....16 "

Greenlee Five-Spindle Borer.

Starting load .....46.6 hp.
Machine running light.....13.3 "
Lightly loaded, 9/16-in. bit in British Columbia pine.....24 "
Medium load, 13/16-in. bit in pitch pine.....26.6 "
Heavy load, 2½-in. bit in green oak.....28 "
Maximum load developed .....28 "

Greenlee H. C. Mortiser.

Starting load .....43 hp.
Machine running light ..... 6.6 "
Lightly loaded, ⅝-in. chisel in green oak, mortising 3 in. deep.13.3 "
Medium load, 1½-in. " 6 in. " 16.6 "
Heavy load, 1¾-in. " 4 in. " 20 "
Maximum load developed.....20 "

Bertram Gainer.

Load varied, 13.3 hp, 16.6 hp, 18 hp, 20 hp; load varied according to crowding and material stock used; green oak, gaining 1 in. deep x 3 in. wide.

Starting load .....20 hp.
Machine running light.....6.6 "

Bertram Rip Saw Table with 27-in. Robertson Saw.

Starting load .....10 hp.
Machine running light..... 3.3 "
Loaded, first cut 5 -in. high x 9-in. wide stock.....13.3 " to 16.6 hp.
Second cut 10¾-in. " x 12-in. " .....16.6 " to 20 "
Maximum power developed.....33.3 "

Bertram Cut-Off Saw, 34 in. Diameter, No. 11 Gauge.

Starting load .....10 hp.
Machine running light..... 3.3 "
First cut 5 -in. high x 9-in. wide stock.....13.3 " to 16.6 hp.
Second cut 10¾-in. " x 12-in. " .....16.6 " to 20 "
Maximum load developed .....20 "

Bertram Four-Headed Matcher.

This machine used to surface top and bottom only in this test. Voltage of motor, 250.

Motor running light ..... 1.6 hp.
Starting load .....30.32 "
Machine running light ..... 12½ "
Light load, pine 1 in. thick in rough, 7½ in. to 9½ in. wide, finished to ⅞ in. thick.....22.6 "
Heavy load, ash 1½ in. rough, finished to 1¼ in., stock 10 to 13 in. wide .....28.3 "
Maximum load developed.....28.3 "

McGregor & Gourley Sticker.

Motor, 250 volts, running light.... 1.6 hp.
Starting load .....26.6 "
Machine running light .....10 "
Load varied .....14.4 "
" to.....24.3 "
Maximum power developed.....24.3 "

These tests show that an enormous amount of power is consumed in the starting up of old wood-working machines, this fact being caused by the number of cogs and gears that get stiff and out of true.

It also shows that old tools may be worked up to a point far in excess of some of the tests previously published. The author hopes that these showings may benefit some of those who are working along similar lines, as he well remembers the trouble he had in getting accurate data on the same subjet.

A Private Wireless Telegraph Service.

It is stated that arrangements are completed for a wireless telegraph station at the country home of W. Gould Brokaw, at Great Neck, L. I. A towering pole has been erected not far from Mr. Brokaw's house and the work of installation is going on.

Pacific Coast Electric Transmission Convention.

The eighth annual convention of the Pacific Coast Electric Transmission Association was held at Monterey, Cal., on June 21 and 22. It was attended by about 100 transmission, central station and supply men and proved to be one of the most successful conventions the association has ever held. Of special interest were the spirited and instructive discussions, the enlarging of the scope of the association and the entertainment furnished by the citizens of the historic and quaint city of Monterey.

In the absence of President H. A. Noble, who was unavoidably called east, Mr. C. H. Pennoyer, of San Jose, called the convention to order and presided over the sessions. Welcoming addresses were made by Mayor R. F. Johnson, R. H. Willey and General Wm. Quinton, all of whom spoke entertainingly of the natural resources of Monterey and of the historical features of the locality, Monterey being the first capital of the State. Papers were then presented to the convention as follows:

"A Proposed Method of Determining Meter Rates for the Sale of Current, with an Example from Data of a Large Steam-Driven Plant," by A. M. Hunt. The paper describes a method involving the use of exponential curves which, when plotted on logarithmic cross-section paper, become straight lines. A curve can be plotted for any customer showing the rate to be charged for any given monthly consumption. The upper limit of the charge will usually be determined by the maximum rate allowed by municipal or other regulation. The lower limit should be placed at a point to compete with the cost of production in isolated plants, or other competing sources. A prospective customer comes in, wanting a contract, and asks for a rate. Ascertain his connected capacity and, by reference to a properly prepared table, mark the upper and lower points on the logarithmic sheet and connect them with a straight line. The rate is established and is a just one to both the consumer and the company. The system penalizes possible peak load by making a gross charge for each kilowatt connected. It recognizes the value of large connected loads, if there is an adequate current consumption, and it gives the small consumer a chance to get the low rate, if his use is heavy in proportion to his possible maximum demand. It does not take cognizance of one important factor, viz.: the proportion of the twenty-four hours during which use is made of the current and the time at which the peak occurs.

In the discussion of Mr. Hunt's paper George C. Holberton, of San Francisco, remarked that the system proposed would probably work out allright in some cases, but stated that the majority of consumers generally prefer a straight flat rate instead of a sliding scale. C. M. Copeland, of Los Angeles, said that when he went with the Edison Electric Company, of Los Angeles, some two years ago, there was in use what was popularly termed a "jumping" rate; that is, consumers having a certain capacity of connected motors paid 14 cents per kw-hour, another class with larger capacity paid 13 cents, and so on, the rate varying by one-cent jumps, so that a plotted line indicating the rates resembled steps. He proposed that a curve be drawn averaging the points on the steps, which would be fairer to the consumer and which would be similar to Mr. Hunt's plan and other similar rate methods. Mr. Copeland expressed his opinion that it was almost impossible to introduce such refinements, as the more simple the rate the better it suited the consumer.

W. G. Clark, of Seattle, Wash., thought a flat rate suited the average consumer better. He said that in a plant with which he was connected they had had in operation for about five months a system by which the customer paid a rate that was based on two-thirds of the number of lights connected, guaranteeing, for example, 50 cents per month for each light, in which case he would get the minimum rate. By guaranteeing 25 cents per month per light he would get a higher rate and so on to a guarantee of 10 cents, for which he would be charged the minimum rate.

Prof. C. L. Cory, of Berkeley, Cal., stated that the investigation which had led Mr. Hunt to devise his plan had grown out of a movement by the Independent Gas & Electric Company to show the supervisors in San Francisco that a flat rate was not a just one. The plan proposed in the paper was destined really to be of more benefit to a central station company than to the consumer, as it enabled the company to find out what kind of customers it had and what fixed rates it should charge them.

In his paper on "Transmission of Power vs. Shipment of Fuel," Mr. A. J. Bowie, Jr., gave interesting data on the relative cost of transporting oil a distance of 150 miles for the generation of 9,000 kw or the installation of a double three-phase, 3/0 aluminum circuit for the transmission of this power. On the assumption that freight for the oil costs 33 cents per barrel, it would pay equally well to install the plant at the center of distribution and ship the oil thereto.

Mr. Bowie's paper evoked a general discussion, in which was also brought out the relation of water power and steam plants. Mr. Allen H. Babcock, of San Francisco, expressed an opinion that if steam turbines had been considered in the paper the price per kilowatt-hour would probably be still further reduced. This led to a discussion of steam turbines, J. A. Lighthipe, of San Francisco, stating that they showed better economy than reciprocating engines. A 2,000-kw Curtis turbine had recently been placed in operation in Los Angeles and a 500-kw turbine in Phoenix, Ariz., but the demands for the power had been so pressing that there had been no time for tests. He mentioned that a recent statement concerning the Chicago Edison Company's Fish Street station showed for the turbines installed there one pound of Illinois screenings better economy than for the Harrison Street station with reciprocating engines.

F. G. Baum, of San Francisco, said the question in Mr. Bowie's paper resolved itself into balancing the interest, fixed charges and operation of transmission line in one case against the cost of fuel in the other, and that as a matter of fact there was very little difference, and what variation there would be in favor of one plan or the other would depend on local conditions. In regard to the figure of $76 given in the paper as the cost per kilowatt, Mr. Baum said that in his work they generally strove to keep the cost under $75 a kilowatt so as to be able to get economical results, although of course many plants did cost much more than that. Mr. Lighthipe cited the case of Bakersfield, where the Power Development Company is selling a great deal of electric power that is generated by water power, while one of the largest oil fields in the country is only three or four miles distant. Even the Southern Pacific Railroad Company, which operates its own oil wells at that point, buys power from this company for the shop motors. His conclusion was that for small units it was cheaper for a consumer to install motors with rented power than it would be to generate his own power.

F. V. T. Lee, of San Francisco, stated that the present freight cost for oil around San Francisco is 42 cents per barrel, and with oil costing that amount for transportation the transmission companies around and north of San Francisco are safe from steam competition. He said a possibility that may have to be met in the near future is the transportation of oil by pipe line, as against the transmission of current by pole line. Mr. Babcock said that in the case of a large consumer of power a vital question was whether he should build his own plant or carry the fixed charges on a steam auxiliary plant belonging to the transmission company. One large consumer of whom he knew had found it more economical to install his own steam plant. Mr. Baum stated that the impression which had been quite prevalent, i. e., that there was a continual fight between steam and water power men, was wrong, and his company, the California Gas & Electric Corporation, was always ready to install whichever plant would prove the cheaper. In answer to a question as to what the cost would be for maintaining steam on boilers in a reserve plant, Mr. W. F. Hanscom, of San Francisco, said that this cost would be very low, as the loss was caused almost exclusively by radiation. Prof. Cory stated that in the test of the boilers of the Pacific Light & Power Company, in Los Angeles, the efficiencies of both boilers were about 80 per cent., and that the loss of heat by radiation when the boilers were doing work was between 2½ and 3 per cent. This would be reduced when the boilers were not working. He emphasized the importance of the question suggested by Mr. Babcock as to who is to furnish the reserve steam plant in the case of large consumers taking power from the transmission companies. The Utah transmission companies and many of those in California stood ready now to guarantee to furnish power continuously to their customers under any circumstances.

The paper by E. G. De Wald, on "High-Pressure Water Wheels, with Particular Reference to the Girard and Francis Turbines," discussed the two types of turbines most commonly used in Europe. In a correctly-constructed Girard wheel the water should take such route as to leave the wheel runner in an exact radial line, and the highest efficiency can be obtained only when it is discharged in this way. The parallelogram of the velocity of discharge acts as a check on the entire construction and shows the designer whether the wheel

is correct or not, while by its use the builders are enabled to predetermine the efficiency of water wheels, under any condition, within 1 or 1½ per cent., and they need not descend to cut-and-try methods for their construction. In the Francis type of turbine the water is conducted vertically toward the center of the wheel shaft, where it is discharged axially, or in the direction of the shaft. The Francis type is the proper design for heads from 10 to 300 ft. The value of 300 ft. must, however, be restricted somewhat, for when the speed and horse-power will admit of its use, the Girard turbine should be employed. The theory of the Francis wheel of to-day is well defined. As in a Girard wheel, the careful designer can closely foretell its efficiency. While the Girard type for a certain diameter and constant head can be changed in speed only 1 per cent. to 1½ per cent., leaving the designer no flexibility, the Francis type of wheel can be changed in the ratio of 50 to 78, being in this respect more flexible than any other type on the market. The author expresses the opinion that the swivel gate, which has been used on all Francis turbines installed on the coast, combines advantages which the cylinder gate can never possess.

In the discussion of Mr. De Wald's paper, Robert McF. Doble, of San Francisco, stated that a tangential wheel was generally regarded as the best water wheel on account of its simplicity, and also because it wore better than a turbine. The runners of a turbine were apt to wear and let the water through.

Mr. R. W. Van Norden, in his paper on "Ice Interference in Power Ditches at High Altitudes," stated that floating snow and anchor ice can be handled and gotten rid of if in not too large quantities, by properly constructed waste wiers, and by numerous screens made of 1½-in. by 4-in. timber. These screens are set up edgewise, and on a slant having a small angle with the horizontal cut. With every mechanical precaution, a large number of attendants is necessary to patrol exposed sections. This menace at the forebay is prevented only by constantly raking the screens and by the introduction behind the bar screens of woven wire to prevent the passage of fine particles. This paper was not discussed.

The report of the standing committee on Standard Polyphase Distribution was read by George C. Holberton, chairman. The committee found so many different conditions governing the various plants that it was deemed best not to make definite recommendations. Instead papers on different subjects such as high-potential insulators, transmission line problems, street railway load, regulation at power house and sub-station, and local distribution had been solicited for presentation at the convention. The committee recommended that regulator heads should be constructed in oil, and that only secondary currents should be used for measuring and indicating instruments. The growing importance of secondary distribution at 200 volts was touched upon and mention made that one company had recently installed 3,000 meters for 200-volt work. The output of 200-volt lamps had been increasing at the rate of 75 per cent. per annum.

In discussing the report, W. G. Clark spoke of the success of the Nernst lamp where proper attention had been given to its care. On account of its efficiency and better distribution of light this lamp was destined to replace the alternating-current arc to a great extent. On the Pacific Coast over $80,000 worth of Nernst lamps had been installed with very few complaints. The 200-volt lamp was the one most commonly adopted.

The paper by H. A. Bullard and Sidney Sprout, on "Possibilities of Single-Phase Currents in Electric Power Transmission," discussed the comparative cost of a three-phase, three-wire system with three different single-phase systems: (1) Two wires overhead, (2) one wire overhead and one underground, (3) only one overhead wire, the ground being used for return.

The last-named system involves the use of one $5,000 artesian well in every 50 miles of line. It is stated that this (3) system requires only two-thirds of the copper necessary for the three-phase system, and that the transmission and distribution by such single-phase system offers sufficient advantage to justify the careful consideration of its merits.

In his paper on "The Alternating-Current, Single-Phase Railway Motor," Mr. W. F. Lamme stated that time will prove that the place for the trolley conductor is either underground or overhead, and not on the surface, and he emphasized the ability of the alternating-current motor to be operated from an under-running trolley for sizes much larger than possible with direct-current machines. The ease of control of the alternating-current motor without waste of energy in resistance and the enormous reduction in the cost of secondary or trolley conductors, which makes possible the extension of the overhead trolley construction to heavy train service, thereby permitting the installation of trunk lines, are the prominent advantages claimed for the alternating-current equipment.

R. B. Elder read a paper on "Single-Phase Motors," in which he called attention to the advantages of the single-phase motor for various classes of work, and especially for all sizes up to about 30 hp, saying that they worked in very well on a polyphase system where the heavy motors were of the three-phase induction type. A large number of single-phase motors had been successfully installed in this way on the Pacific coast.

The papers of Messrs. Bullard and Sprout, Lamme and Elder being on similar subjects, were discussed together. Prof. Cory stated that one wire of a single or three-phase system could never be grounded as mentioned in Mr. Bullard's paper if anybody ever expected to use a telephone in the State. A general discussion ensued on the relative merits of single-phase and polyphase motors, the general sentiment being that the polyphase motor was a splendid machine and had not yet reached its highest stage of development, while the single-phase motor at present seemed to be commercially useful only in small units. In reference to Mr. Lamme's paper, Mr. Babcock brought out the point that with a single-phase railway system the energy required to bring a train up to maximum acceleration was greater than that required for the train at full speed, and with several trains on a system there would be a very large extra demand for power which did not seem to be accounted for in the paper or in other publications of the manufacturers of that system. Mr. Clark said that he had made an interesting investigation into the relative merits of the single-phase and direct-current systems for a 25-mile railway in which he was interested, and that the figures for the single-phase system showed a saving of only 1¾ per cent. over the old system. He had planned for a 6,000-volt system with 250-volt motors and a capacity of 2,000 kw. Frequency changers would have to be installed to change the 60-cycle to 25-cycle current. In running over the track of a direct-current system he found it would be better to install a separate alternating-current trolley than to use complicated apparatus on the car in order to operate by direct current. The single-phase road would be bonded effectively and no serious trouble was anticipated from telephone wires, as the road was removed from a populated district. Mr. Babcock stated that in planning an 8,000 to 10,000-kw installation he had found that in first cost the alternating-current and direct-current systems were very nearly alike, differing by less than 1 per cent., and that the difference was so slight that it might easily be represented by the error of the figures. The operating costs would be less for the direct-current than for the alternating-current, and if reasonable caution should be exercised they would be compelled to install the direct-current system, because it was less complicated. The system of which he spoke would include operation from the company's own power house. Mr. Holberton questioned the statement in Mr. Lamme's paper as to the impossibility of operating trains of medium size by means of an under-running trolley, stating that on the Key route on the Oakland side of San Francisco Bay, six and eight-car trains are frequently operated with a special under-running trolley.

The paper on "A New Type of Telephone," by H. G. Aylsworth, described a telephone adapted for use in connection with high-tension service, which has been designed by R. W. Van Norden. The principle features of the telephone reside in the precautions taken to insulate the exposed parts of the instrument so as to render it safe for handling and to protect it from injury due to static discharges or an accidental cross of the telephone wires with the transmission wires. The induction coil takes the form of an oil-insulated transformer. The receiver is entirely covered with hard rubber so that no metal is exposed. All exposed metal parts of the transmitter, as well as the telephone, are insulated from the telephone circuit. Fuses protect the instrument from all ordinary crosses and grounds.

At the evening session on Tuesday some interesting stereopticon views were shown by W. W. Briggs, illustrating the "Practices and Products of the Westinghouse Shops." This was followed by a very instructive and entertaining lecture by Robert McF. Doble on the Guanajuato transmission system in Mexico. The lecture was illustrated by a large number of lantern slides, which illustrated the diversion dam, canal, pipe line, power house and transmission line. In the discussion several interesting facts were brought out concerning the wages and methods of handling the native laborers, the erection and construction of the steel towers, etc.

In his paper on "Medium-Span Line Construction," Mr. Clem A. Copeland related the experience of the Edison Electric Company, of Los Angeles, with several methods of distributing systems, having particular reference to pole line construction. Four miles of experimental line were installed in two sections—one in the Lytle Creek district near San Bernardino, two miles in length, consisting of three-strand No. 5 copper, and the other at Anaheim of seven-strand No. 5 copper. In the former section a 500-ft. span was inserted. All other spans of both sections were 225 ft. in length. It was found that there existed an advantage in medium (225 ft.) or long-span work over that of ordinary spans (130 ft.) due to the greatly reduced trouble with insulators and pins and the burning off of poles on account of making the parts fewer in number and better in quality. Such improved construction also greatly reduces the necessity for double-pole lines. In concluding, the author states that by effecting a saving from 10 to 30 per cent. in lines ordinarily costing from $700 to $1,700 per mile and having from three to twelve of the smaller sizes of wire, a slight advance has been made in the art, where the cost of poles, freight and haulage is great.

Mr. Doble, in the discussion, stated that on the Guanajuato line the company was required by law to keep the cable seven meters above the ground, and the spans and allowable sag were very carefully figured out and diagrams and charts prepared for use in erecting the cable. On the longest span, of 1,320 ft., a sag of 60 ft. was allowed. The minimum span was 440 ft., and for that a sag of 7 ft. was allowed. In all cases the sag must be in proportion to the distance between the poles. They had had no trouble from the wires swinging together. Mr. R. W. Van Norden said that with a span of No. 6 solid copper wires across a cañon on the Central California Power Company's system no trouble was had even though the wires would be frequently coated with wet snow to a diameter of 6 in. During winds the wires would swing uniformly together and would not come in contact. Mr. Hutton mentioned that the resistance of solid copper wire was less by about 1 per cent. than for the same area in stranded cable and thought that it would pay to tin the cable in order to decrease its resistance. Mr. Lighthipe, in speaking of the swinging of the wires in long spans, said that they probably did not tend to come in contact because the catenaries swung in unison as pendulums. Mr. Hanscom had noticed that there was no tendency to swing into contact of three No. 12 copper wires strung 5 in. apart with 600-ft. span and about 4 ft. sag. Mr. B. C. Condit, of Stockton and Reno, Nev., stated that on the Truckee River General Electric Company's system they had had considerable trouble from the wires swinging into contact, but it was probably due to the unusually severe winds of that locality. The wires are of No. 4 copper and are strung 30 in. apart with ordinary spans. Mr. Aylsworth said that in telephone work the wires frequently swing together. Mr. Hutton spoke of some lines near Sacramento and mentioned that the swing of the poles out of "synchronism" with the swing of the wires produced a jumping effect and the wires frequently came together. Mr. Copeland cited the case of a 500-ft. span with 9-ft. sag and 53 in. between wires, where no trouble had been experienced from swinging.

"Some Experiences in the Regulation of a Three-Phase, Four-Wire Mixed Distribution" was the subject of a short paper by C. W. Hutton, in which he described some of the troubles met and solved on the three-phase, four-wire system in Sacramento. When the system was first installed several years ago the phase wires were given the same relative positions on all the poles and for each phase wire there was placed immediately below a pressure wire, but these latter were rendered useless, as the potentials indicated at the stations varied anywhere from 95 to 150 volts for a 115-volt system. A four-wire cable was then adopted for the pressure wires, which was very satisfactory. Other troubles arose, the phase wires were transposed and the system was only put on a satisfactory basis when the present system of bank transformers was installed, in connection with an I. R. T. regulator.

Under the title of "The Regulation of Transmission Lines," J. A. Lighthipe gave a description of the construction and theory of operation of the Tirrill voltage regulator, and displayed charts taken by Bristol recording instruments, which showed the improved service after the regulator was installed in the power house at Spokane, Wash.

Supplementary to Mr. Lighthipe's paper, Prof. Cory presented the data in the following table, as showing the condition for a 90-mile, 60-cycle, 60,000-volt transmission line with the use of a Tirrill regulator in connection with a synchronous motor. Four conditions were presented, the assumption being that the voltage at the receiving end was maintained constant at 60,000 volts:

Length of Line, 90 Miles, 60 Cycles, 60,000 Volts at Receiving End. Circuit Three No. oal wires, 48" Apart.

	Line open no load.	3000-kw delivered power factor 100%.	3000-kw delivered power factor 80% lag (such as induction motor load).	3000-kw delivered power factor 80% lead (unusual condition).
Load receiving end	None	3,000-kw	3,000-kw	3,000-kw
Power factor receiving end	.....	100%	80% lag	80% lead
Power factor gen. end...	1.7%	85.8%	99.7% lag	66% lead
Voltage rec. end	60,000	60,000	60,000	60,000
Voltage gen. end	58,870	63,073	65,478	60,829
Current from gen. start ..	19.3	34.5	28.7	49.6
Kw loss on line	33.1	236.3	248	457
Effic. of transmission	.....	92.7%	92.4%	87%
Line loss per cent. watts..	.....	7.1%	7.7%	12.4%
Voltage regulation per cent.	2%	4.9%	8.4%	1.4%

A paper prepared by R. S. Masson, of Los Angeles, was then read on testing of high-tension insulators. Mr. Masson described a 16-mile line north of Ontario, Cal., belonging to the Pacific Light & Power Company, on which tests had been made to determine the type of insulators to be adopted for the company's 125-mile, 40,000-volt transmission from Kern River to Los Angeles. The experimental line consisted of No. 4 copper wires and the test voltage was run up to 80,000 volts. The conclusion from the tests was that the company would have no trouble in operating its Kern River line at 60,000 volts if it wished to.

A report of the special committee on "Resuscitation" was presented by Robert McF. Doble and C. W. Hutton and an interesting physical demonstration of resuscitating persons and carrying them on litters was given before the convention by Prof. Frederick H. Killick. The question of having a large number of copies of Dr. McGowan's paper, presented before the National Electric Light Association at the Chicago convention last year, printed for general distribution among the physicians and transmission companies of the State, was left in the hands of the committee.

ASSOCIATION BUSINESS AND ELECTION OF OFFICERS.

At an executive session of the members of the association the society was reorganized on broad lines so as to include for future membership all companies and individuals engaged in the generation, transmission or distribution of electricity. The dues of full members were raised and dues of associate members lowered. Dr. F. A. C. Perrine was delegated to represent the association at the International Electrical Congress, to be held in St. Louis during September. Letters of regret were read from many members who were unable to be present and a telegram of the same nature was received from President Noble. Upon motion, the secretary was instructed to send a telegram of greeting to the American Institute of Electrical Engineers, which was holding a convention at the same time in Chicago for the discussion of papers similar in nature to those presented at Monterey.

A cordial invitation was read from H. W. Goode, of Portland, Ore., president of the Portland General Electric Company, and also director-general of the Lewis-Clark Exposition, inviting the association to hold its 1905 convention at the exposition. The matter was referred to the executive committee for consideration, the sentiment being strong in favor of the acceptance of the invitation. The following-named officers were elected for the ensuing year: President, H. W. Goode, president Portland General Electric Company, Portland, Ore.; vice-president, C. H. Pennoyer, manager United Gas & Electric Company, San Jose, Cal.; secretary and treasurer, George P. Low, San Francisco. The executive committee was divided into three classes, the term of offices of the different classes expiring year after year. The members of the committee will be appointed by the president.

CONVENTION NOTES.

The custom of holding a manufacturers' exhibition, so common with eastern conventions, was inaugurated at the Monterey meeting. For the exhibition hall a new store building convenient to The Monterey, the convention headquarters, was utilized and a very

interesting and comprehensive exhibit was arranged. The exhibitors included the following:

The California Electric Works, of San Francisco, Pacific coast branch of the Western Electric Company, was represented by E. L. Wayman, Pacific coast sales manager; H. M. Squires, consulting engineer, and H. C. Hasselback, superintendent of supply department. A large line of Western Electric fans, fuses, switches, lamps and other supplies was shown, as well as a complete exhibit of high-voltage porcelain insulators, manufactured by the R. Thomas & Sons' Company.

The General Electric Company exhibited a full line of its supply goods, as well as arc lamps and heating appliances, and was represented by J. A. Lighthipe, engineer; H. A. Russell, salesman machinery department, and E. M. Jones, salesman supply department, all from the San Francisco office.

The Stanley Electric Manufacturing Company, Northern Electric Manufacturing Company, Fort Wayne Electric Works and General Incandescent Arc Light Company were represented by F. V. T. Lee, Pacific coast manager, and Wm. Eckberg, salesman, both of San Francisco. Large photographs were shown of some of the installations of these companies.

The Wagner-Bullock Electric Company, of California, had an interesting working exhibit of a single-phase Wagner motor, as well as a complete switchboard installation. R. B. Elder, manager, and A. J. Myers, head of the sales department, looked after the company's interests, and incidentally were instrumental in increasing the company's wide circle of friends.

Prof. Frank E. Smith, San Francisco representative of the Weston Electrical Instrument Company, was in attendance and displayed several of the latest types of Weston switchboard and testing instruments.

Pacific coast manager R. B. Daggett, of the Electric Storage Battery Company, looked after his company's interests and as an exhibit displayed in the exhibition hall several large photographs illustrating a few of the many battery installations which have been put in on the coast during the last year.

Charles C. Moore & Co., of San Francisco, were represented by Lyman F. Trumbull, who displayed some Chapman valves and other steam specialties.

Probably the most popular booth was that of Kilbourne & Clark, of Seattle and San Francisco, in which was exhibited a Cooper Hewitt mercury vapor lamp, some Nernst lamps and other specialties. A working exhibit to which San Francisco manager H. G. Aylsworth pointed with pride was a 160-kw, two-phase generator and a two-phase motor-generator, both manufactured by the National Electric Company, and installed in the power station of the Monterey County Gas & Electric Company. W. G. Clark, the Seattle member of the firm, was present throughout the convention and took active part in all of its proceedings.

The Brooks-Fallis Electric Company, of San Francisco, had an interesting exhibit of Kellogg telephone instruments, Anyun high-voltage oil fuses and other specialties.

F. J. Cram, Pacific coast representative of the Electric Appliance Company, of Chicago, was in attendance at the convention and took pleasure in informing the delegates that his company had recently opened up a San Francisco branch at 717-719 Mission Street, where he would be glad to see all of his Western friends.

Among others noted among the convention attendants were Will F. Hall, of John A. Roebling's Sons Company; Robert McF. Doble, of the Abner Doble Company, and Mr. Ward, of the Pelton Water Wheel Company.

The interests of the ELECTRICAL WORLD AND ENGINEER and other publications of the McGraw Publishing Company were looked after by C. W. Whitney, Pacific coast representative, and Edward B. Bolger.

George P. Low, the popular secretary of the association, was constantly on hand looking out for the interests of the delegates. On the convention train going down from San Francisco, Secretary Low distributed to the delegates, with the compliments of the *Journal of Electricity, Power and Gas,* handsome convention badges bearing an enlarged fac-simile of the association's official emblem.

The social features of the convention were well arranged and included excursions on Monterey Bay, trips to the curio stores, Spanish missions, and places of historic interest, and trolley rides to Pacific Grove and that famous hostelry, Del Monte, while the ladies were entertained with a drive over the famous 17-mile drive. On Wednesday evening an enjoyable banquet was served at The Monterey, and the convention closed with a clambake on the following day.

Hydro-Electric Development at St. Etienne, France.

Some weeks ago we printed a note relating to an interesting hydro-electric development near St. Etienne, France, and through the courtesy of Mr. Hilary S. Brumot, United States Consul at St. Etienne, we are enabled to give further particulars.

For many years the municipal government of St. Etienne has been impressed with the necessity of increasing the water supply of the city. The present supply, inaugurated some 60 years ago, gave every satisfaction until in recent years, when by reason of the increasing population on the one hand and successive years of drought on the other, the supply became manifestly insufficient.

It was therefore considered necessary to relieve the situation. Convinced that the streams in the neighborhood could not be counted on to furnish an adequate volume of water, attention was turned to a small river running through the adjoining department (Haute Loire) called the Lignon, a tributary of the Loire River, which from its size could be depended on to furnish not only an unlimited supply of water for domestic purposes, but also for many of the industries of the region.

Plans for the utilization of this source were prepared and the work is now in the hands of contractors, and good progress has already been made. The water is to be brought by means of a subterranean canal running from a point about 35 miles up the country. This canal is expected to be completed in two or three years. At the point where the Lignon will be tapped a large reservoir is being built capable of holding 1,000,000 cu. meters of water; a second dam will be constructed higher up (three miles) for 3,000,000 cu. meters as a reserve. The canal will be in the form of a large cemented tube, 60 in. in diameter.

While this enterprise was under consideration it occurred to the engineers that the same river could also provide power for electrical generating purposes, since the canal would provide an available head of 200 meters. As the Lignon will furnish 5,000 liters per second during 12 hours each day, 5,500 kw capacity of electrical energy could be available, which it was calculated could be furnished at the annual rate of 30 francs per kw.

To carry out this scheme a loan of 8,000,000 francs was authorized and the construction of the dam begun, the face of which will be 165 ft. high, capable of providing 6,000 liters per second. The normal volume of water is reckoned at 2,250 liters per second, and falling from a height of about 650 ft., this will produce 5,940 hp; the engineers, however, have provided in the plans for the possible employment of 7,405 hp. Three-phase current will be generated at 12,000 volts. The chute (penstock) will be composed of two pipes of sheet steel, each 2,408 ft. in length.

The machinery necessary for this enterprise has not been as yet selected. A large number of firms have sent in offers and in some cases their engineers have appeared to explain the advantages of their systems, but no conclusions have been arrived at up to the present, and tenders are still coming in.

The specifications require that the turbines shall be horizontal so as to allow the easy control of the bearings during their function and permit the dismounting of the turbines without removing the alternotors.

The alternators will be coupled to the turbines and capable of furnishing 1,200 hp each at 300 revolutions per second. To excite the generators direct-current dynamos of 150 kw will be connected to the shaft of the turbines.

The transmission lines will be double and the poles will be 35 ft. high placed 100 ft. apart. The insulators will be of the triple bell type and capable of sustaining 20,000 volts. Every mile and a half each cable will be protected by a lightning conductor, while the cables will be furnished with a switch every four miles so as to isolate a line or section in case of necessity. The length of the lines will be about 50 miles. The whole undertaking is reckoned to cost over 8,000,000 francs.

Besides the water and electric power works above alluded to and belonging to the municipality of St. Etienne, there is another project being studied as a private enterprise which involves the distribution of electric power and light not only to St. Etienne, but to the principal towns of the department of the Loire.

M. Mallet, civil engineer at St. Etienne, is the promoter of this scheme and has great hopes of seeing it realized. The water will be taken from a high point in the department of the Ardeche, the source being a small lake one and a half miles in diameter. The energy expected to be derived from this source is calculated at 20,000 hp.

All the industries of the region will benefit by these undertakings, as the power supplied will be cheaper than that of the present steam engines. Authorization has been applied for by the engineer above named for permission to begin operations, and if the necessary sanction is given by the government, the use of electricity will be largely substituted for steam in this great manufacturing section of France.

CURRENT NEWS AND NOTES.

IN WIRELESS TOUCH ALL THE WAY ACROSS.—The Cunard steamer *Campania* arrived at New York on Saturday last after being in continuous wireless communication with one shore or the other during the entire Atlantic voyage. News was received for the daily paper from Poldhu for a distance of 1,500 miles, and after that the Cape Breton station was communicated with and supplied the daily budget. Telegraphic news was published every day.

ELECTRIC TRACTION ON LACKAWANNA RAILROAD.—We understand that the Lackawanna Railroad is contemplating the experimental operation of two storage battery cars on its Montclair branch. The cars are to be equipped with Edison storage batteries and the plan is to run the cars between Newark and Montclair during the middle of the day when traffic is light. The distance between the two points is between 5 and 6 miles. Such an increase of facilities will be welcomed.

ITALIAN ELECTRICAL VISITORS.—Prof. M. Ascoli, president of the Associazione Elettrotecnica Italiana, writes that no fewer than 41 members have already formally engaged themselves for the trip to America, arriving in two parties about August 24-25. The official representatives will be Prof. Ascoli and the two vice-presidents, Prof. G. Grasi, of Turin, and Prof. L. Lombardi, of Naples. The delegates of the Italian Government to the Electrical Congress will be Prof. Ascoli on behalf of the Ministry of Posts and Telegraphs, and Prof. Lombardi, for the Ministry of Public Instruction.

NO LIGHT AT NEW BRUNSWICK, N. J.—Lightning struck an exposed main of gas near the generating station at New Brunswick, N. J., on July 7, knocking a small hole in it. The main filled with water. The water got into the entire section of pipe leading from the station and effectually sealed every outlet of gas to the city. The electrical supply was also interrupted. All of the street gas lamps went out and hundreds of homes were thrown into darkness. The Board of Education was in session and was compelled to send out and borrow lamps. The Board of Health got along by using candles. Many a man had to go without a warm breakfast next morning. Cooking stoves have been stored and thousands of gas stoves are in use. These stoves were useless.

TRANSFORMER.—A patent issued July 5, 1904, to W. S. Moody on an application filed December 14, 1903, is chiefly interesting in showing that patents sometimes issue on features long well known in the art to which the invention applies. The object of the invention is to obtain good regulation in a variable-ratio transformer, and the means employed can best be understood from the two claims allowed: (1) In a transformer, the combination of two inductively-related windings each made up of a plurality of coils, the coils of one winding being connected in series with each other and the coils of the other winding in multiple with each other, and connections for utilizing less than the whole number of series-connected coils. (2) The combination of a transformer having one of its windings arranged so that a portion or portions thereof may be left out of circuit, and an inductively-related winding having all of its coils or sections connected in multiple with each other.

BLOWING UP STREET CARS.—Three street cars were blown up with dynamite at Houston, Tex., last week and the public is terror-stricken. The depredations are charged to street car strikers, who have waged a bitter but unsuccessful warfare against the company. One car was blown from the rails at noon time, the running gear was shattered and five passengers were injured, three seriously. A whiskey bottle containing the explosive was used. Filled with dynamite, it was laid on a car rail. Threats have been made that every car will be blown up. Rewards of $5,000 have been offered for the arrest of the perpetrators. Citizens are greatly exercised and vigilance committees were being formed at last reports. All cars are being operated with armed guards.

COMPOSITE CARBON ARC LAMPS.—In order to prevent the formation of scoria around the points of the upper carbon of his lamp, which employs composite or flaming carbons, the upper one being surrounded by a dome or reflector provided with a refractory base, which prevents the vapor passing away, thus allowing the fumes to be maintained in the arc, Prof. A. Blondel, in a patent issued July 5, 1904, proposes to surround the upper carbon with a protecting envelope of carbon (not mineralized) and to provide by suitable mechanism for the feeding of the envelope forward at a rate such as to allow the mineralized carbon always to project slightly out from the envelope. According to a second method which he proposes, the thickness of the envelope may be so chosen that it is consumed at the same rate as the inner carbon, and the carbon remains always flush with the envelope or projects slightly from it.

WATER POWER SURVEY IN NEW YORK.—The appropriation of $1,500 recently made by the New York State Legislature for co-operative hydrographic work with the United States Geological Survey will be used in maintaining records of the rise and fall, the ordinary outflow, floods and droughts of many streams in the State. By means of these records it is possible to determine in specific cases the water supply available for canals, public water systems and hydro-electric utilization. The condition of streams in more than fifty places in the State is regularly reported. The work has gradually grown until there is at present hardly a section of the State in which some river is not systematically measured. The list includes Chemung, Allegheny, Susquehanna, Chenango, Catskill, Delaware, Hudson, Mohawk, Saranac, Oswegatchie, Genesee, Oneida, Seneca, Oswego and Black Rivers, and their most important branches. The developed water power of these streams amounts to nearly 300,000 hp, and they afford an almost unlimited amount of undeveloped power. Mr. Robert E. Horton, hydrographer, of Utica, N. Y., has charge of the work.

LETTER TO THE EDITORS.

The Government Use of Wireless Telegraphy.

To the Editors of Electrical World and Engineer:

SIRS:—Inasmuch as Mr. Glaubitz, in criticising statements made in your columns of June 22, has ventured certain misstatements concerning the De Forest wireless system, permit me, as president of the American De Forest Wireless Telegraph Company, to say that the recent experiments which the United States Signal Corps have concluded with a combination of the De Forest and Signal Corps systems, coupled with the eminently satisfactory results which the army has had during the last two years with the De Forest system, have decided its introduction in Alaska over a range where two years ago the Fessenden system was ordered installed, and where, up to date, it has never made good.

The fact that Captain Wildman calls the present system the "De Forest-Wildman" is fairly satisfactory proof as to what elements are actually involved.

The official reports of General Greely and Colonel Dunwoody as to the relative performance of the De Forest and other systems during the war manœuvers of the last two years, and the number of sets of De Forest apparatus purchased by the War Department during the time, will convince the most sceptical. During this period Fessenden was employing the hot-wire "barretter" and not the electrolytic receiver, which receiver, I have the best evidence to show, was discovered, not by Fessenden, but by Mr. F. K. Vreeland, in

the former's laboratory, and which electrolytic receiver the former has seen fit to claim and style his "liquid barretter."

The American De Forest Wireless Telegraph Company happens to be in a position to state that their system as used by the Signal Corps in Alaska will not "embody the wave chute" (rendered necessary by the frozen ground of Alaska), which wave chute, by the way, is the original invention of Dr. De Forest; neither the "high-frequency steel guy supports," nor the "liquid barretter." Its elements are amply covered by patents to De Forest and Shoemaker, or pending to these and Captain Wildman, U. S. A.

Regarding the navy's attitude toward American wireless, had Mr. Glaubitz waited one week for the recent announcement of contracts between the Bureau of Equipment and the American De Forest Wireless Telegraph Company, for such important stations as Cuba to Panama, to Porto Rico, Key West and Pensacola, he would have found it quite unnecessary to accuse the navy of undue partiality to a German system. These contracts, the largest and most important ever entered into by ours or any other navy department, are the result of the recent official tests of the De Forest system, and coupled with the fact that the Weather Bureau is now equipping two stations on the Pacific with De Forest apparatus, shows how competent government officials of the various departments regard the merits and claims of this system.

NEW YORK CITY. ABRAHAM WHITE,

President American De Forest Wireless Telegraph Co.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Large Commutator.—An illustrated note describing the various steps in large commutator construction. The bars are hard-drawn copper, sawed slightly larger than the size desired when finished, or they may be drop-forged, in which case they are stamped out to the proper size. Cast bars have been tried, but in the process of casting particles of sand become mixed with the copper, which renders such bars useless. The sides must be smooth and have the necessary taper for producing a commutator of a certain diameter.

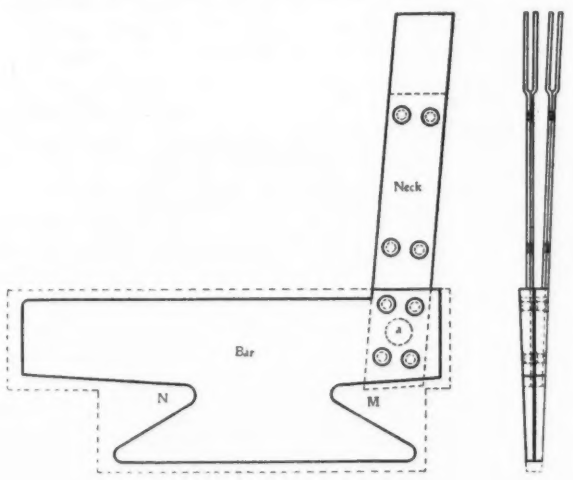


FIG. 1.—LARGE COMMUTATOR.

In Fig. 1 the bar and neck are shown joined together. The dotted lines represent the bar as it is sawed out and built into the commutator; the full lines represent the shape of the bar after the commutator has been machined. The bar has the well-known dove-tail projection, universally used in commutator construction, to act in conjunction with clamping rings to hold the bars in place. The form of the neck here shown is employed on most of the medium and large-size machines and consists of two strips of copper, fastened together by two or four copper rivets according to the length of neck, and has a recess at the top for connecting the armature strap winding. The hole, *a*, ½ in. in diameter, is punched in the neck and the rivet holes about *a* are drilled with the bar and neck held firmly together. After connecting the two with copper rivets the bar and neck are brazed together. After brazing the bars are finished off smooth at the joint and are ready to be built up in the commutator. The manufacture of mica insulation and the methods of building up the commutator and testing it for short-circuits are also described.—*Elec. Club Jour.*, June.

REFERENCES.

Diagrams.—NIETHAMMER develops a general diagram of alternating-current phenomena for alternators, synchronous motors, converters, double-current generators and non-synchronous motors and generators. In the same issue Begnet gives some numerical figures, supplementing a former article on diagrams of induction motors.—*L'Eclairage Elec.*, June 25.

Transformer Coil Winding.—Some notes giving practical rules for winding transformer coils.—*Elec. Club Jour.*, June.

LIGHTS AND LIGHTING.

Electricity and Light.—STEINMETZ.—The efficiency of light production by the present methods is discouragingly low. In the candle, the kerosene lamp and the ordinary gas lamp probably less than 1 per cent. of the energy is realized as light. In the incandescent lamp an efficiency of perhaps 2 per cent. is reached, and hardly 5 per cent. in the carbon arc lamp, the most efficient source of light now in use. It is really heat that is produced and light appears almost as a mere by-product. In recent years avenues of research have been opened and are being energetically pursued in the research laboratories of electrical manufacturing companies, with the object of replacing the present indirect and inefficient methods of light production by a more direct transformation of electric energy into light with a far higher efficiency. Only solids and liquids follow the temperature law of radiations, by which the ratio of visible to total radiation is a function of the temperature, increasing with the increase of temperature. In gases the vibrations of the molecules, like those of a tuning fork, are of a definite period or wave length, or usually a number of such wave lengths. Here the ratio of the visible to the total radiation depends on the chemical and physical characteristics of the gas and may be very high. When supplying heat to a gas no vibration of the molecules is produced; other means must be applied for this purpose, such as chemical reactions or electrical excitation. The author discusses the use of impregnated carbons for arc lamps and then deals with the direct method of producing luminosity in vapors by using them instead of carbon as carriers of the current in the arc, replacing the carbon altogether by some other conducting substance which gives a luminous flame. The mercury arc and the magnetite arc are mentioned as examples.—*Cassier's Magazine*, June.

POWER.

Limitations of Power Transmission.—LINCOLN.—A discussion of the limitations of long-distance electric power transmission. There are first commercial limits beyond which electrically-transmitted power ceases to return a profit. Much depends on the price which can be demanded for the power delivered. Kelvin showed that the total cost for transmitting power would be a minimum if the annual cost of power lost in transmission is equal to the annual interest, depreciation and maintenance charge on the transmission plant. Others have later pointed out that there are elements in the annual interest, depreciation and maintenance charge of the transmission plant which are independent of the amount of copper used, and that maximum economy is secured if the variable element in the item just mentioned becomes equal to the annual cost of loss of power in the line. If a transmission plant is designed for maximum economy, the percentage increase in cost of power at the receiving end over the cost of power at the transmitting end is at least double the percentage loss. For instance, if a 10 per cent. loss in a given transmission proposition gives maximum economy, the cost of power at

the receiving end must be at least 20 per cent. greater than at the generating end. The author then discusses limits due to engineering considerations. The principal point is insulation. The highest voltage actively in use at present is about 55,000. The difficulties in increasing the voltage of transmission are due to the requirements for the maintenance of perfect insulation, of proper protection from lightning discharges and other static troubles, the loss of power on account of brush discharges, and the deterioration of the high-tension conductors because of the fact that compounds which attack the metal are formed by the action of these brush discharges upon the atmosphere. Present indications are that no increases of voltage of a revolutionary character may be expected in the immediate future. A handy rule for estimating the cost of copper in a transmission system is this: If the voltage of transmission in thousands of volts is equal to the miles of distance, the cost of copper for that transmission, assuming copper at 20 cents per pound, will be very close to $5 per kw transmitted. This is based upon the assumption that the loss is 10 per cent. For other losses, other distances and other voltages one has to consider that the weight of copper is directly proportional to the square of the distance and the amount of power transmitted, and is inversely proportional to the square of the voltage used and the loss that takes place in the conductors. For instance, if the miles of transmission are double the number of volts expressed in thousands, the cost of copper will be four times that stated above, or $20 per kw for a 10 per cent. loss. If in this case the loss be increased to 20 per cent. the cost of copper will be one-half, or $10 per kw. The total cost of any transmission system, including cost of generating station with all appliances, cost of prime-movers and buildings, cost of receiving station, will probably be at least $75 per kw and usually much more. The author gives some numerical examples.—*Cassier's Mag.*, June.

Electric and Hydraulic Cranes.—A long and full account of tests made at Middlesbrough Dock of the North-Eastern Railway, where hydraulic and electric cranes are working side by side, so that their relative advantages may be compared. The installation is described in detail. The traffic department finds the electric cranes to be of great advantage. The controlling of the crane by one handle is a distinct advance both over the steam and the hydraulic cranes. The automatic cut-off in the electric cranes interrupts the current in one case at 3 tons 5 cwt., and the other at 10 tons 10 cwt., and this device prevents an overload on the crane. Should the current fail at any time, the brake on the lifting gear is applied automatically and will hold the full load on any position in safety. To obtain some definite idea of the speeds of the various cranes when working under ordinary conditions, they were tested separately. The steam crane had a load of two tons put on and this was lifted 30 ft., carried transversely through 106.5 ft., lowered 30 ft., light hook lifted 30 ft., carried 106.5 ft., and lowered 30 ft. The total time for these operations was 1 minute 44 seconds, or at a rate of 34 cycles per hour. The hydraulic cranes, under precisely the same conditions, occupy 1 minute 40 seconds per cycle, or equivalent to 36 cycles per hour. The electric cranes did the same work in 64 seconds per cycle, or 56 cycles per hour, and this is capable of being increased beyond even this point with a good driver. Therefore, in ordinary working, electric cranes are doing 50 per cent. more work per hour than the hydraulic or steam cranes. On actual test it was found that the electric cranes can be released from the rails, moved 30 ft. and refixed to the rails in three minutes. When it was necessary to remove the hydraulic cranes, to suit the work into the various ships' holds, six men had to be called out one hour earlier in the morning to set the four cranes which are required for each vessel. With the electric cranes the men need not be called earlier, since two men in summer and four in winter can disconnect and connect up four cranes in 15 minutes. In winter, on frosty nights, four men have been employed six hours each for keeping fires to prevent water in the cylinders of the hydraulic cranes from freezing; with electric cranes there is no need for this. When the steam crane has to be gotten ready for work, the driver has to commence one hour earlier in order to obtain steam, whereas the hydraulic and electric cranes are ready for work at any moment. The actual saving effected by electric cranes in the cost of handling cargo is 25 per cent.—Lond. *Elec.*, June 24.

Electric Power at Dock Yards, Booster and Balancer Arrangement.—The first part of an illustrated description of the electric plant at Heysham Harbor, which is being built by the Midland Railway Company. In addition to arc and incandescent lighting, the electric plant supplies current to the whole of the electric cranes, capstans, lifts, etc. The system adopted is the 2 x 230-volt, three-wire system, the incandescent lamps being connected on the 230-volt mains, the motors across the 460-volt outers and the arcs, which are of the enclosed type, two in series on the 230-volt mains. There are three 150-kw dynamos driven by gas engines supplied with Mond gas. The auxiliary plant consists of four boosters and the balancer. The two-battery boosters are automatically reversible, each with a shunt-wound motor driving a 16-kw generator and a 5-kw exciter. They can increase the pressure by hand regulation of their exciters from 0 to 80 volts for charging at 200 amp., and decrease it 0 to 45 volts on discharging up to 300 amp., and can also be set to work automatically on varying power loads so as to charge up to 200 amp. and discharge up to 300 as loads vary. The speed is 950 r.p.m. The booster motors are connected in series across the three-wire system, and can be used as a balancer, the sets being then mechanically coupled together. The booster itself is separately excited by a small generator on the same shaft, and this generator is differentially compound-wound, one of its field windings being connected to the bus-bars and the other to a very low-resistance shunt on the bus-bars between the main generators and the outgoing feeders. The boosters have also a series winding on their fields carrying their main current, this winding causing a cumulative effect to take place. The lighting feeder booster is made up of two 7½-kw series generators, driven at 850 revolutions by a shunt motor. The machine is designed to increase the pressure by 25 volts on each side of the lighting feeders when necessary, and to deal with a currrent of 300 amp. Each of the generators of this machine has, in addition to the series winding, a second series winding connected in series with the middle wire. Thus, when there is a large out-of-balance current flowing through the middle wire, the pressure on the more heavily loaded side is automatically increased, and the middle wire drop is compensated for. In addition to this, there is the usual cross-connected balancer, consisting of two 24-kw machines running at 950 r.p.m. The power feeder booster is an ordinary booster, capable of raising the pressure 35 volts and dealing with 250 amp. of current. It is driven by a motor at 400 r.p.m. The comparatively large battery consists of 230 cells, capable of supplying 180 amp. for six hours, 300 amp. for three hours, or 540 amp. for periods up to 30 seconds.—Lond. *Elec.*, June 24.

Electric Versus Gas Power.—CANNING.—An account of some tests in which an electric motor and a gas engine were simultaneously used to do the same work for one hour. The consumption of gas was 110 cu. ft. and the consumption of electrical energy 4.38 kw-hours. The cost of the gas is given as 7.48 cents, and that of the electrical energy 8.76 cents. In this case the consumption of gas corresponding to 1 kw-hour electric energy was 25 cu. ft., but it is thought that in a new gas engine of the latest type the figure for gas consumption would be much lower. He gives a table to show that an electric motor has no real chance in competition with the modern gas engine, especially when working under full load.—*Am. Gas & Light Jour.*, June 27.

REFERENCES.

Power Transmission.—SCOTT.—An article on the economic and engineering aspects of long-distance power transmission. The one fundamental thing which underlies the adoption of alternating-current systems for transmission is the transformer. The critical and limiting element is the transmission line. High voltages introduce exacting requirements upon the insulators, which are subjected to mechanical strains, and must, therefore, possess adequate mechanical strength; their material must be such as will resist puncture from the constant electrical stresses which are brought upon it, and their form and dimensions must be such as to prevent the passage of a trivial current over the surface, which would quickly result in the formation of an arc. He briefly discusses lightning arresters, switches and refers to the work of the power transmission committee of the American Institute of Electrical Engineers.—*Cassier's Mag.*, June.

Cupola Fan Practice.—CARRIER.—A paper giving very full data as to the operation of centrifugal blowers for cupola service, including the air supply required per pound of coke used and per ton of iron produced; the relation of pressure, size of cupola and speed of melting; the horse-power required for various sizes of cupolas at different pressures, corresponding to different ratios of melting; the relation of speed, pressure and capacity of centrifugal cupola

blowers; the effect of piping resistance upon the pressure and horsepower.—*Iron Age.*, June 23.

Power in Factories. D. C. AND W. B. JACKSON.—A long and fully-illustrated discussion of the use of electric power in manufacturing plants.—*Cassier's Mag.*, June.

Shawinigan Falls.—JOHNSON AND MERSHON.—A long and very fully-illustrated description of the hydraulic development and the electric power transmission plant at Shawinigan Falls, Canada.—*Cassier's Magazine*, June.

TRACTION.

Point Shifter.—An illustrated description of an electrically-operated point shifter which may be worked by the motorman of any car without the addition of any extra appliance whatever to the car or any alteration of its wiring. The cast-iron street box, *B*, in the elevation in Fig. 2 contains a powerful electromagnet or solenoid,

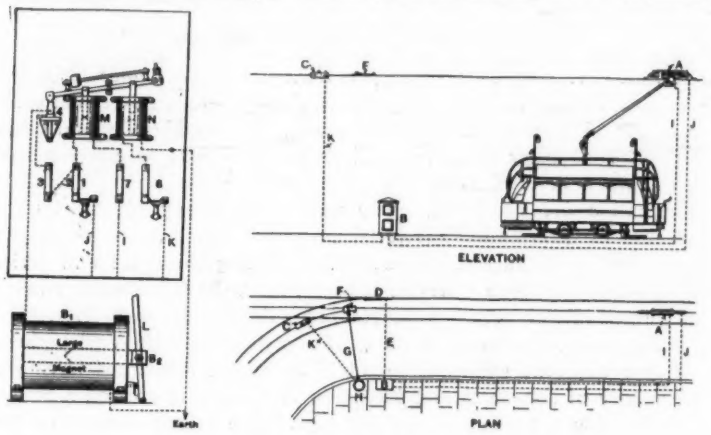


FIG. 2.—POINT SHIFTER.

B_1, wound to suit the line voltage and having a core of suitable size and stroke to pull over both the rail point and that of the overhead wire. The core, B_2, is connected to the rail point tongue, *D*, by rod *E*, and also to a lever, *L*, projecting upward, so that, when desirable, the points may be actuated by hand. A flexible steel cable, *G*, connected to this lever, *L*, is carried to the overhead point, *F*, and is adjusted so that the necessary movement is obtained, when the lever is thrown over either by hand or by the magnet, B_1. The working of this magnet is controlled by an electrically-operated switch mounted in the same street box. The switch consists of two electromagnets, *M* and *N*, mounted as shown, side by side, with their cores connected to a pivoted lever forming the moving portion of the switch, at one end of which are the switch contacts, 4, well insulated from the lever. At the other end of the lever is an adjustable balance weight, so that when the core of magnet *M* is attracted the switch is closed, and when that of magnet *N* is attracted the switch is opened. The closing of this switch completes the circuit thus: From the overhead trolley wire by means of cable *J*, main switch and fuse 1, connecting wire 2, fuse 3, switch 4, magnet B_1, to earth or rails, thus causing the core of magnet B_1 to be attracted and the points pulled over. On the switch being opened the core is released and the points resume their original position owing to the tension of a powerful spring. The necessary current for working magnets *M* and *N* is derived from the line as follows: At a position some convenient distance short of the rail point, a section insulator, *A*, of the air-gap type is fixed in the trolley wire. By means of the insulated cable, *J*, which is connected to the overhead wire at insulator *A*, and run down the pole bracket, *H*, to box *B*, current is conveyed to the main switch and fuse 1 to magnet *M*, from there to return to fuse 7 and back through the wire, 1, to the insulated piece of the section insulator, *A*. A cable, *K*, is also run from the hanging switch, *C*, to the box, *B*, and on to the switch and fuse, 6, and is then connected to the magnet, *N*, from whence it returns to the rails. If on approaching a junction the motorman does not intend to turn on to the branch route, he will, on nearing insulator *A*, switch his motor controller off and coast through the insulator, thereby not interfering with the points in any way. Should he, however, desire to turn on to the branch line, he would, on approaching the section insulator, *A*, keep his controller on. Current would then flow from the line by means of wire *J* to switch and fuse 1, through magnet *M*, return to fuse 7, wire 1 to insulated piece, *A*, down the trolley to the motors and thence to rails. The large magnet would then become energized owing to the switch, 4, being closed, and it would, therefore, pull over the points. The car having passed these points, now comes to the hanging switch, *C*, and this being closed by the trolley head, a current is sent through the wire, *K*, to the switch and fuse, 6, through magnet *N*, and thence to the rails. Switch 4 is thus opened, and the core of magnet B_1 is released, allowing the points to resume their original positions.—Lond. *Elec.*, June 24.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Distribution from Transmission Systems.—BELL.—An article in which the writer says that while engineers are willing to take all sorts of chances in the matter of voltage and line construction, there is a general lack of proper appreciation of the conditions of regulation, and a singular lack of enterprise in dealing with this part of the work. The question of regulation is the crucial point and the regulation must begin at the water wheels and continue up to the last consumer. Up to the generator switchboard there is generally no trouble in fulfilling this condition, and the fundamental requirement for good service is the proper design of the distributing lines. "The devil-may-care influence of the old house-to-house alternating-current methods is still strong upon the art, and it is singularly difficult to persuade the organizers of an alternating distribution to pay the necessary tribute to Ohm's law." Given a transmission line, brought into a sub-station fairly well located, the question of good service resolves itself into the matter of suitable regulation of the voltage. This involves taking care of a total drop of, say, 10 per cent. in the main line, and perhaps 5 per cent. more up to the services. The vital question of good service is the question of this drop. The simplest case is that of a single sub-station near the center of load. The most often successful policy is here to give the generators automatic regulation for the preservation of constant pressure at the sub-station and then to use manually-operated regulators on the feeders at the station. It is best to carry the automatic regulation through to the secondary side of the reducing transformers, so as to lessen the work required in feeder regulation. The commonest and most difficult case is that in which the same long transmission line gives service for two sub-stations with mixed loads, one at the end of the line and the other, perhaps, midway, with possibly still other stations at other points. In this case it is obviously impossible to give automatic regulation for more than one point along the same line, and the variations of voltage are apt to be embarrassingly large. Sometimes the trouble may be dodged with duplicate circuits. Failing in this, it is rather difficult to give good service without resorting to somewhat drastic remedies. To meet such cases the problem of automatic feeder regulation on polyphase distributing circuits ought to be worked out.—*Cassier's Magazine*, June.

ELECTRO-PHYSICS AND MAGNETISM.

Resistance Standards.—WOLFF.—An abstract of a Physical Society paper on the peculiar behavior of some resistance standards and its explanation. Certain paraffin-insulated resistance coils have formerly been found to show polarization effects due to the application of the test current. The same behavior is noticed occasionally, even with coils insulated by shellacing and subsequent baking, and is to be attributed to an electrolytic shunt, the polarization of which causes an apparent increase in the resistance as the test current is left on. On the reversal of the test current the resistance is apparently too low, but gradually increases to its former value. The effect is produced by dipping a coil which does not show the effect in water and is eliminated by subsequent baking. Another effect manifests itself by a decrease in resistance as the test current is left on, the amount of decrease depending upon the voltage applied to the coil. The variation is irreversible, depending upon the previous currents and their direction, and the behavior is exactly similar to that of a coherer resistance. The effect cannot be accounted for by thermal or voltaic e.m.f's, and probably consists of a coherer shunt to a portion of the coil, due to a metal filling imbedded in the shellac between turns. As Branly has shown, such coherer effects may be obtained even with solid dielectrics.—*Phys. Rev.*, June.

A Radium Clock.—A note on what might be called a radium clock, exhibited by R. J. Strutt at a recent Royal Society conversazione. It works on the following principle: A specimen of radium salt in a glass tube is hung up by an insulating support in an exhausted vessel. An electroscope is attached to the radium tube. Negatively-electrified particles are shot off by the radium and penetrate the

glass tube, which is covered with a conducting coating of phosphoric acid, so as to act as an inductor. Thus a positive charge is left and causes divergence. When the electroscope touches the outer vessel, which is earthed, it collapses and begins to charge up again. This will go on as long as the radium lasts.—Lond. *Elec.*, June 24.

Energy Density in a Magnetic Field.—BARNETT.—A Physical Society paper on the energy density, tension and pressure in a magnetic field. The general expression for the magnetic energy density at a point at which the induction is proportional to the intensity is obtained by equating the volume integral of the energy density in the field of a simple circuit in a medium in which the induction is everywhere proportional to the intensity, to half the product of the current in the circuit (expressed as $\frac{1}{4}\pi$ times the line integral of the magnetic intensity around it), and the magnetic flux through the circuit, and comparing the two expressions. The expressions for the magnetic tension and pressure at a point at which the induction and intensity are proportional and parallel are simply and rigorously obtained by the application to simple circuits of Maxwell's relations between the change in the electrokinetic energy of a system, with constant fluxes or constant currents, and the work done by the electromagnetic forces when the system undergoes an infinitesimal change of configuration. The magnetic pressure is also deduced from Ampere's law.—*Phys. Rev.*, June.

ELECTRO-CHEMISTRY AND BATTERIES.

Edison Accumulator.—SCHOOP.—The first part of an article illustrated by diagrams in which the author gives an account of an experimental investigation in which he studied the concentration changes and diffusion phenomena which take place in the pores of the electrodes of an oxygen-lift cell. This method consists in suspending the accumulator electrode under test on the beam of a balance and observing its changes of weight while current is flowing and after it is interrupted. Since the concentration of the KOH solution between the two plates of an Edison cell does not change during discharge, the changes of weight observed by weighing the plate in the solution are due to the following causes: First, the change of weight due to oxidation or reduction which can easily be calculated on the supposition that the cell is an oxygen-lift cell. Secondly, there may be a contraction or expansion of the electrode plates; any contraction manifests itself by an increase of weight of the plate in the solution, since now a smaller volume of solution is displaced than before. Thirdly, there is a change of the concentration of the solution in the pores. This latter change can be rendered negligible by discharging the cell at a very low rate, so that diffusion and convection have time to counteract all concentration changes. The author gives results obtained with an iron electrode at a very low discharge rate. The curves show that the measured increase of weight of the iron electrode more than corresponds to the oxidation of the iron. From this he concludes that the plate has undergone a contraction. He then gives the results of a test of the same electrode with a very high discharge rate. In this case the concentration changes take place in the pores of the plate, in accordance with the theory. When the current is interrupted at the conclusion of this test, the weight of the electrode increases, since now concentrated solution rushes into the pores, which contain very dilute solution; simultaneously the e.m.f. increases. Results are also given of tests of a cadmium electrode. The article is to be concluded.—*Electrochem. Ind.*, July.

Electrometallurgy of Iron and Steel.—STANSFIELD.—A long abstract of a paper read before the Canadian Society of Civil Engineers in which the author states that electrical energy can be bought in Canada on a large scale at the price of about 0.15 cent per electric hp-hour, or 0.20 cent per kw-hour. If, then, the reduction of one metric ton of pig iron from ore requires 2,500 kw-hours, the cost of the energy comes to $5. Against this may be set the price of fuel saved, which is about 0.6 ton of coal, which at $2.50 per ton is equal to $1.50 per ton of iron. Thus electric smelting of such ores as are capable of treatment in the blast furnace cannot compete with the latter, even where cheap water power is available, unless the price of coke is as high as $8 per ton. There are, however, certain ores, such as iron sands and titaniferous ores, which can only be treated with difficulty in the blast furnace; in these cases the electric furnace may be useful. Moreover, refractory ores exist which can be treated only when they prove suitable for reduction in the electric furnace. Probably the greatest field for the electric furnace in the iron industry will, however, be found in the production of crucible steel. Electric heating also should replace the open hearth furnace in the manufacture of the more expensive varieties of steel, where the cost of fusion is less important than the soundness of the metal. The author believes that the electric manufacture of crucible steel is technically and financially possible in Canada, and that furnaces might be constructed for the preparation of tool steels, which are now largely imported.—Lond. *Elec. Rev.*, June 24.

REFERENCES.

Artificial Graphite Electrodes.—COLLINS.—A fully-illustrated description of various types and forms of Acheson graphite electrodes as used in commercial electric furnace and electrolytic processes.—*Electrochem. Ind.*, July.

Electrochemical Laboratory.—GOODWIN.—A fully-illustrated description of the electrochemical laboratory of the Massachusetts Institute of Technology.—*Electrochem. Ind.*, July.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Direct Treating Apparatus for Calibrating Resistance Boxes.—WOLFF.—An abstract of a Physical Society paper. In precision comparisons of the coils of resistance boxes, the variable plug and other contact resistances introduce serious errors unless special methods involving a determination of such connecting resistances for their elimination are employed. The method described by the author consists of determining the relative values of the coils belonging to a decade or to adjacent decades by shunting these coils in series with each other by a series of 100-ohm coils, the galvanometer being connected in turn across corresponding points of the two series. The apparatus is made direct reading by applying a Kelvin-Varley shunt to four adjacent coils of the auxiliary series, the shunt having a resistance of 400 ohms and including in its middle portion a bridge wire having a range of ± 1 per cent. The relative values of the coils are given by the differences in the readings obtained, and it is, therefore, necessary to determine the value of only one of the coils of the series to determine the values of all in international ohms. The method is applicable to boxes in which the coils may be put in series and in which a galvanometer contact may be applied to the contact blocks to which the coils are attached. In the series plug rheostats this may be accomplished by means of a split plug, one-half of which is composed of insulating material.—*Phys. Rev.*, June.

MISCELLANEOUS.

Electroculture.—An article stating that much interest is paid at present in various European countries not only to the application of electricity for power purposes in agriculture, but also to the influence of electricity on the culture of plants itself. In France quite recently the Minister of Agriculture sent to prefects and sub-prefects a circular instructing them to facilitate in every possible way the application of electricity to agricultural operations and setting forth the advantages which agriculture and industry in general would derive therefrom. In Belgium the application of electricity in agriculture has been introduced into the university curriculum and Guarini was officially instructed to deliver a series of lectures on the subject. He emphasizes that, contrary to what is believed and taught, it is not electricity that can be substituted for light in certain cases in the accomplishment of the function of chlorophyll, but, reversely, the light of the sun or of arc lamps, with its electrical radiation, can be substituted for purely electrical treatment. To prove this fundamental point, he describes the following experiment: If a plant is placed in a pot which is entirely enclosed in a metal cage (a Faraday cage) it dies, although it is exposed to the sunlight. The reason of this is, according to Guarini, that the plant is deprived of the indispensable influence of atmospheric electricity and particularly of the electric radiations of the sun. On the other hand, if a plant is placed in absolute darkness, it can produce much finer and more abundant fruit in less time than under natural conditions, if judicious electrical treatment is applied to it. He gives some hypothetical considerations as to how electricity may influence nutrition, respiration and transpiration. Concerning nutrition, it is said that the current which passes through the plant from the atmosphere to the earth or vice versa, decomposes the carbonic acid in the chlorophyll into carbon and oxygen. The currents which pass through the earth decompose the chemicals in the earth and form nourishment more easily assimilated by plants. There is also an electro-capillary effect by which if the potential of the earth is

positive and that of the atmosphere is negative, water and elementary substances are drawn up in the plant, so that the circulation of the sap is promoted. As to the apparatus best adapted for the application in practice, he favors high-tension, continuous-current dynamos. By using them instead of the atmosphere as a source of electricity, the electrical treatment can be regulated at will. He refers to a direct-current dynamo recently built, giving 1 amp. at 23,000 volts. By coupling three such machines in series, a voltage of 69,000 is obtained, which is more than sufficient for electro-culture. "Plant life is an electrical phenomenon which can be regulated at will. The farmer will no longer be a mere machine, but a skilled and more or less intelligent electrician, who, like an engine driver, will direct from a board at the farm the germination and growth of his carrots, potatoes and cabbages."—Lond. *Elec. Rev.*, June 17.

REFERENCES.

Electric Heating and Cooking.—KREJZA.—The conclusion of his illustrated article. The author gives the formulas for calculating the wire resistances required for such purposes.—*Zeit. f. Elek.* (Vienna), June 12.

Color Photography.—A. AND L. LUMIERE.—A description of a new method of photography in natural colors, somewhat similar to Joly's method, except that colored starch grains are substituted for tinted gelatine lines.—*Comptes Rendus;* abstracted in Lond. *Elect.*, June 17.

Manufacturing Cost.—An article giving formulas, illustrated by diagrams, for calculating the cost of manufacture, with special reference to dynamo manufacturers.—*Zeit. f. Elek.* (Vienna), June 19.

Electric Welding.—ELIHU THOMSON.—An illustrated account of the development and the applications of electric welding.—*Cassier's Magazine,* June.

New Books.

DYNAMOMASCHINEN FÜR GLEICH UND WECHSELSTROM. By Gisbert Kapp. Berlin: Julius Springer. 620 pages, 255 illustrations.

The fourth edition of this standard work has been revised and considerably enlarged, one of the most welcome additions consisting of an up-to-date review of recent advances in single-phase working. The book starts with elementary explanations of electromagnetic phenomena, which lead up to the principles embodied in dynamo electric machines. After a short chapter devoted to the magnetic properties of iron, the formula for the e.m.f. of direct-current machines is developed. We then pass on to a consideration of the more common types of direct-current windings, to which the author devotes considerable space. In the main he follows Arnold's "Die Ankerwicklungen der Gleichstrom Dynamomaschinen," but takes up only the more usual forms of windings. A short chapter is devoted to the old Siemens shuttle armature and to the Brush and Thomson-Houston machines. Various types of field frames are described and their respective advantages compared, and the determination of the exciting current from the dimensions of a machine is illustrated in an example. The subject of commutation is treated very fully, and has been brought into line with recent work on this subject. A short chapter devoted to tests and a chapter describing foreign direct-current generators, close the direct-current part of the work.

Coming now to the alternating-current part of the work, in the first few chapters the author derives the e.m.f. equation of alternating-current machines, and various types of windings of alternating-current generators are briefly considered. The power in an alternating-current circuit and the effects produced by self-induction and capacity in a circuit are next taken up. Only a few pages are devoted to polyphase systems and only one method for determining the power in three-phase circuits is given. The paucity of matter on this subject contrasts strongly with the fifty pages following, devoted to the parallel operation and hunting of alternating-current apparatus. Kapp considers the parallel operation to be both an electrical and a mechanical problem, but with modern machines the problem is almost entirely a question of the regulation of the prime-mover. A short, well-written account of the theory of anti-hunting or damping devices closes the chapter. In contrast with his very thorough treatment (for a text-book) of parallel operation, the author dismisses with scant ceremony such a subject as the regulation of alternators. No mention is made here of what Mr. Behrend so aptly designates the pessimistic and optimistic regulation curves.

After a brief discussion of the theory of synchronous motors we come to asynchronous motors, in which the author develops a general vector diagram and then its simplification into the well-known Heyland diagram. For the non-mathematical reader the author has worked out a proof in which mathematics are avoided.

We now pass to an interesting part of the book in which the author considers the recent developments in single-phase and polyphase work. The compensated asynchronous motor of Heyland is described and its derivation from the Görges motor shown. The reversibility of this compensated, or as Heyland says, compounded, motor, into a generator, is shown and elucidated. Latour's method of compounding alternators is explained at some length, the author basing his exposition principally upon a recent Institute paper by Mr. A. S. Garfield. The author next considers the theory of the repulsion motor, the method of treatment being entirely mathematical. The theory of the compensated single-phase series motor is next considered and the Winter-Eichberg modification is described. The author mentions the Lamme motor, but does not describe it. Latour's combination of repulsion and series motor, in which the advantages of both types are combined, is treated briefly: the motor starts as a repulsion motor and is connected as a compensated series motor when near synchronous speed. While the treatment of these various machines is not as complete as may be desired, it must be remembered that the development of single-phase motors is so recent that it is difficult to predict which type of motor will be the one to survive.

Converters are treated in the next chapter and a few types of alternators, mostly ancient, are described in the last chapter.

No list of symbols, of which many are used, is given, and in consequence it is sometimes difficult to find the meaning of certain symbols.

The value of the book to the American engineer lies chiefly in the part devoted to alternating-current apparatus, which Kapp has brought thoroughly up to date. Considered as a text-book for the use of students, it does not rank with Prof. S. P. Thompson's "Dynamo Electric Machinery."

WECHSELSTROMTECHNIK. By M. T. Zsakula. Leipzig: A. Hartleben. Four volumes. 264 + 216 + 200 + 200 pages, illustrated. Price per volume, 4 marks.

This work consists of four volumes, the first of which treats theoretically the principles of alternating currents. Volume II is devoted to polyphase systems, Volume III to alternating-current generators, and Volume IV to transformers and alternating-current motors.

The reader is led by easy stages into the theoretical consideration of the effects of resistance, inductance and capacity in alternating-current circuits. The treatment is simple and easily understood, the various quantities are represented by vectors and the solutions of examples are by trigonometric methods. Methods of measurement in connection with alternating-current circuits are explained briefly.

The subject of polyphase currents is introduced by a chapter devoted to the historical development of polyphase apparatus. Two and three-phase systems are treated at considerable length, the phase, current and voltage relations being fully discussed. No trouble will be experienced in following the mathematical treatment, as the author's methods of development are simple. A peculiar chapter follows devoted to five, six, eight, twelve and n-phase systems; the six and the n-phase systems are perhaps of theoretical interest, but the others are of academical interest only and could very well have been omitted. Various problems, such as the size of wire required for transmitting single-phase and three-phase currents, phase relationships in a three-phase unbalanced system, copper required by various systems, etc., are treated briefly.

In Volume III 90 pages are devoted to a well-illustrated historical account of the development of alternators. Somewhat peculiarly, the author describes various types down to a period of eight or nine years ago, and then stops. At some length he discusses the shape of the e.m.f. wave for various widths of coils and poles, and distribution of the conductors. In a final chapter of this volume the relationship between the various e.m.f's in an alternator is considered by the aid of vector diagrams. Such diagrams as shown

may apply to circuits, but the question of regulation of an alternator is a more complex relationship than would be inferred from the work.

In Volume IV, thirty-six pages are devoted to the historical development of transformers, but as in the case of alternators no modern types are described. A chapter devoted to the working of the loaded transformer gives very clearly and simply the fundamental theories of the transformer; the vector diagram is developed and Kapp's well-known diagram for regulation is given. Following, the author treats of the synchronous motor, the action being considered in connection with vector diagrams. The treatment of the induction motor is brief but clear, the Heyland diagram being included. In the last few chapters the compensated induction motor of Heyland, the single-phase series motor and the single-phase induction motor are briefly treated. In considering the series motor a few points are given which are to be observed in the design of this m. .or for the improvement of the commutation. A diagram somewhat similar to the Heyland diagram is developed, the originator of this diagram being the well-known writer, Julius Heubach, whose monograph on the single-phase series motor is contained in Vol. IV of "Sammlung Elektrotechnische Vortraege."

One great advantage of the work that will appeal to the majority of readers is the simplicity and clearness of presentation. The book does not pretend to give an exhaustive treatment of any one subject, and its value to those who are able to read German will lie chiefly in referring to it for clearer conceptions of electrical problems. Mathematics are used sparingly, calculus appears at rare intervals, and the non-mathematical reader will generally have little difficulty in following the author's exposition of the subject.

Compendium of Drawing. Chicago: American School of Correspondence, Armour Institute of Technology. Two volumes. 410 + 477 pages, illustrated. Price, $3 per volume, $5 per set.

This work fills a want that has been long and widely felt in the engineering as well as in the architectural departments of our colleges and technical institutes. It is written by men who are specialists in the subjects which they treat, and whose experience as instructors has shown them exactly what to teach and how to teach it. The compendium is written primarily to meet the peculiar requirements of correspondence classes. If any qualities should shine out conspicuously in such manuals, they ought unquestionably to be simplicity and clearness—clearness in the presentation of the matter and simplicity in its expression. The member of a correspondence class usually devotes the evening hours to his technical work; he is often tired in body and sometimes weary in mind, and therefore needs all the intellectual help that the instructor can give him. Difficulties must be foreseen and forestalled, suggestions plentiful and the road made as easy as possible.

These desiderata have been well kept in mind by the writers of the various parts of the compendium of drawing. Some subjects—shades and shadows, for instance—have inherent difficulties which are intensified by the want of oral explanation. The section on lettering is rather meagre in some respects, while somewhat voluminous in others of less importance. Moreover, there is no apparent reason for repeating instructions on lettering in different parts of the work. Perspective is well handled as also the whole subject of mechanical drawing. The test papers are good, but hardly numerous enough; the problems are well graded, increasing in difficulty with the progress of the student.

This Compendium of Drawing will be of much service to the draftsman and student, as well as to the teacher of mechanical drawing.

A New Electric Burglar Fire Alarm.

A simple device has been invented by Mr. Henry E. Vineing, electrical engineer of the Fire Alarm Department of New York City, for protection against burglars, floods and fires. One of the chief merits of the contrivance is its simplicity and cheapness. In short, the apparatus consists, in its simplest form, of four screws, two strips of brass, a screw eye and a piece of cotton or string, applied with the necessary wires and battery.

The operation of the device is as follows: The cotton is first tied securely to a screw eye, drawn taut across the opening to be protected and attached to the spring hook in such a manner that the cotton holds the spring away from the back screw and the front strip of brass. By turning on the switch, thereby connecting the necessary electrical apparatus to the spring circuit, a burglar, flood and fire alarm are secured.

If a burglar should enter he presses the cotton and draws the spring against the front contact, thus sending in his own alarm. If a water pipe should burst, the cotton becomes wet and shrinks, pulling over the contact. In case of fire, even in its incipient stages, the cotton is consumed, the spring then falling back to its original position, making contact with the back screw, which is also connected with the electrical circuit, and thus sending in an alarm.

The system can be somewhat elaborated upon so that it will give separate alarms for fire or burglar and flood, by arranging the spring to work as the armature of a two-point relay. Further, the system is applicable to either closed or open circuits.

Generating Plant of the Glass Block, Minneapolis.

About a year ago William Donaldson & Co., the leading retailers of Minneapolis, Minn., secured the services of Messrs. Kees & Colburn, architects, and C. F. Haglin, contractor, for the erection of a building, to be the best, most convenient and up-to-date that money could buy. The completed building, with its notable fronts of glass and iron, and its six stories and full basement, is an ornament to the city and attracts the attention of all visitors. It justly deserves its popular name, "Glass Block," as over 75 per cent. of its fronts, of 166 and 232 ft., is plate glass, and when illuminated by the 3,500 incandescent lights on the exterior and 400 arc lights within, it presents a brilliant picture.

One of the greatest attractions in this mammoth establishment is the engine room, the "power and light parlor." The floor is white ceramic tiles of special design; the walls are brown tiles to a height

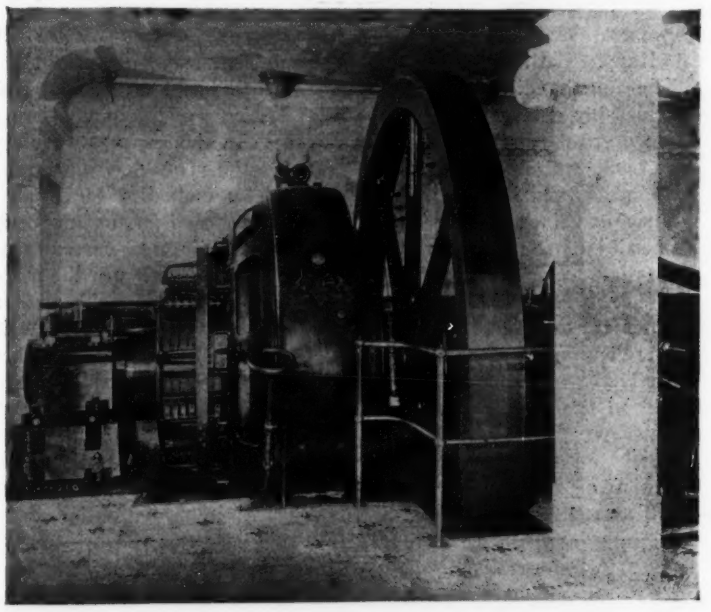


FIG. I.—ONE OF THE GENERATORS.

of 4 ft. Above this the walls and also the ceiling are beautifully tinted; all columns and other trimmings, including a very handsome switchboard, are of pink Tennessee marble.

The handsome and efficient machinery in this room is in keeping with the room itself. The fuel bills since the building was enlarged, notwithstanding the greater demand for light, heat, ventilation and elevator capacity, are actually smaller than before the enlargement. These results have been brought about by the use of Corliss engines with direct-connected generators of high efficiency, by the more economical system of heating and ventilating, but perhaps most of all by the method employed for pumping the water used for operating the six passenger elevators and two freight elevators.

The power to operate this pump, which is of the horizontal, flywheel type, is the exhaust steam from either of the other engines that may happen to be in use (and one or the other of the light-producing engines is always in use when the elevators are needed).

This exhaust steam is taken and used in the steam cylinder of the pump without, it is claimed, producing any back pressure; in fact, relieving the back pressure on the first cylinder, from which it is exhausted. This very low pressure necessitates a large steam cylinder in proportion to the water cylinder. In this case the steam cylinder is 46 in. in diameter and the water cylinder is 10 in. in diameter, the water being pumped against 120 pounds pressure. The steam cylinder is provided with Corliss valve gear. The condenser used with this pumping engine is known as the evaporative surface condenser, using, it is stated, less than one pound of water per pound of steam condensed. It contains 1,260 brass tubes 1 in. in diameter, 66 in. long, lying horizontally in a cast-iron case or body, into which the exhaust steam from the pumping engine cylinder is conducted. At one end the shell is extended and into this extension is introduced a 1½-in. pipe provided with a "rose" head, which divides up the water into a great number of small sprays, and under a pressure of about 25 pounds per sq. in. delivers it into these tubes. Connected to the other end of the condenser shell is a ventilating fan 90 in. in diameter, running at 340 r.p.m., which draws its air through the tubes of the condenser and incidentally ventilates the engine room. This fan draws considerable warm vapor from the condenser tubes; its discharge is conducted to the outside atmosphere. The cooling water is circulated by a small centrifugal pump. The air pump used with this condenser is a 10-in. x 12-in. duplex belt-driven air pump. The air pump, circulating pump and fan are driven by an Electric Machinery Company motor, using 40 amp. at 110 volts.

A 300-kw unit is composed of a 22-in. x 48-in. Twin City Corliss engine running at 100 r.p.m., built by the Minneapolis Steel & Machinery Company, and a generator of the capacity named, built by the Electric Machinery Company, of Minneapolis. Within a few feet of it is another unit of 150 kw, built by the same firms, comprising a 16-in. x 36-in. Corliss engine and a direct-connected generator. This unit has a speed of 125 r.p.m., which has now been maintained for nearly four years without the least trouble of any kind. The next unit is the 12½-ton Linde ice machine or ammonia compressor, built by the Fred W. Wolf Company, of Chicago, and operated by a 12-in. x 30-in. Twin City Corliss engine. This machine is used in connection with the cold storage stock rooms for furs, flowers, bakery, tea rooms, etc.

The heating and ventilating plant consists of one 20-ft. x 6-ft. fan directly-connected to a 12-in. x 30-in. engine at a speed of 140 r.p.m. This fan supplies 90,000 cu. ft. of fresh air to the store every minute. The building at all times is supplied by its own artesian well with pure fresh water for drinking and other purposes. The well is 12 in. in diameter, drilled in the rock 772 ft. The water is pumped to a 3,500-gallon tank on the roof, from which it is drawn as needed. This well is supplying drinking water for the entire school system of the city. There are drinking fountains placed on each floor besides a large one placed on the sidewalk outside for the use of the public.

To Mr. F. M. Overholt, chief engineer, upon whose shoulders Mr. Donaldson placed the entire responsibility of enlarging and remodeling the power and light plant, the success and high economy of this plant is entirely due. The pump noted was designed and built by the Minneapolis Steel & Machinery Company, in accordance with Mr. Overholt's ideas, and he has been granted a patent on the arrangement.

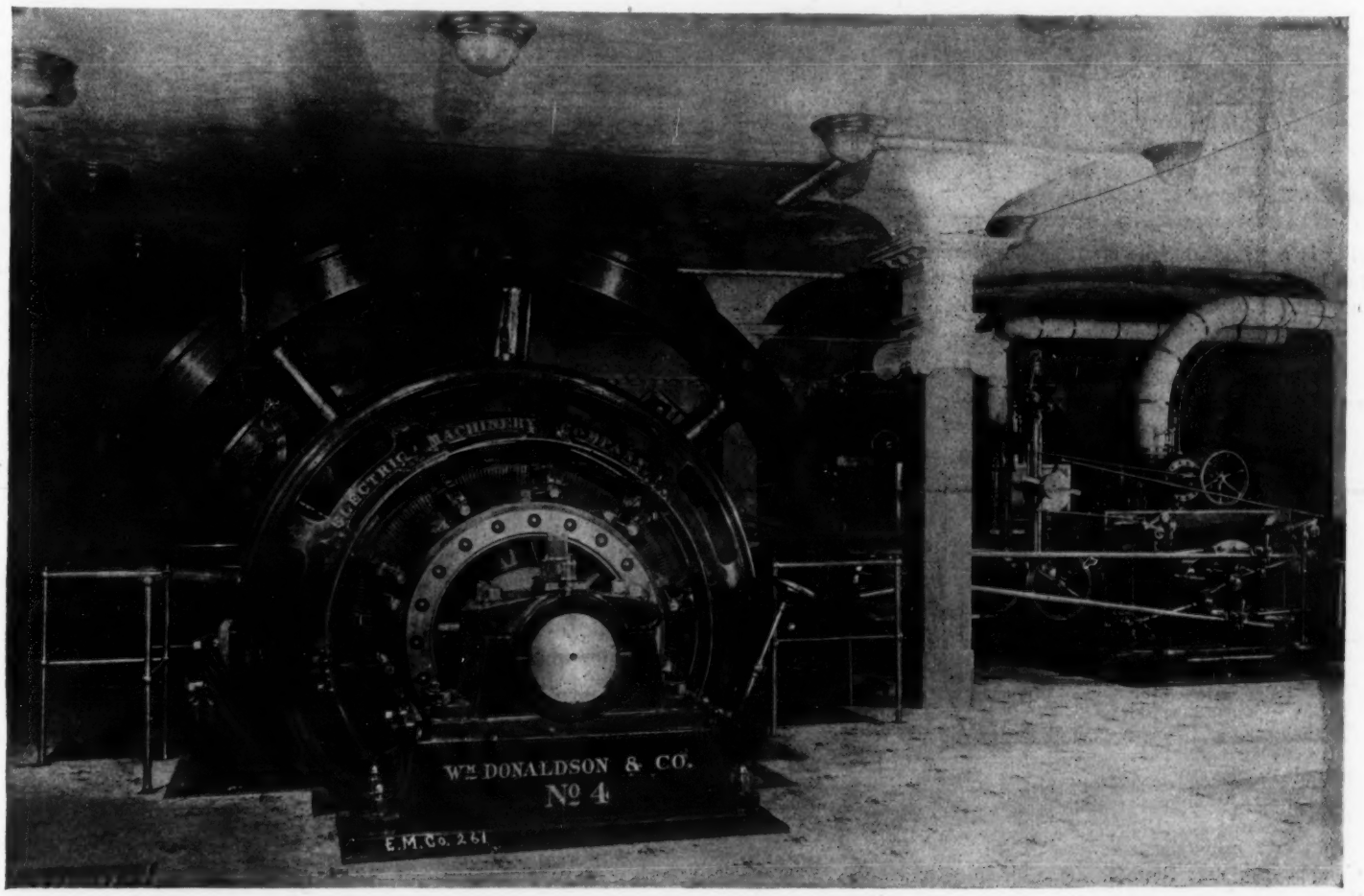


FIG. 2.—GENERAL VIEW OF ENGINE ROOM.

A Washable Storage Battery Cell.

One difficulty in handling storage batteries has been that of removing from the bottom of the cell the accumulation of sediment, without damaging the grid. In the ordinary form the leads must be disconnected in order to remove the cover and take out the grids. The difficulty and danger of damage attendant upon this method of cleaning prevents usually the removal of the accumulation until the battery has deteriorated and possibly become short-circuited.

In the storage battery cell illustrated herewith the grids are left undisturbed during the cleaning, which is accomplished by a stream of water entering through a hole provided for this purpose in the top of the cell and carrying out the sediment through another hole in the bottom. The round hole in the cover is of sufficient size to admit the end of the nozzle of an ordinary garden hose, and is closed with a screw cap. A hole in the bottom 2 in. in diameter, this being somewhat larger than the upper hole, is closed with a plug of special design, the cross-section of which is clearly shown. This plug consists of two discs of acid-proof metal having a ring of pure rubber between them around the outer rim. A thumbscrew draws the

discs together and squeezes the rubber out against the sides of the hole, thus sealing the opening.

In operation, the bottom plug is removed and the electrolyte is run out, strained and saved for repeated use. Then the hose is used to wash the interior of the cell thoroughly, after which the bottom

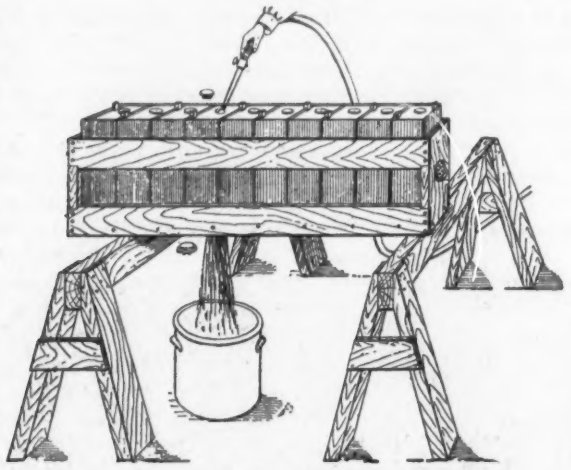


FIG. 1.—WASHABLE STORAGE BATTERY.

plug is inserted and the electrolyte replaced. This washing process can be done by a novice and can be done at frequent intervals without danger of damaging the battery. The Chicago Storage Battery

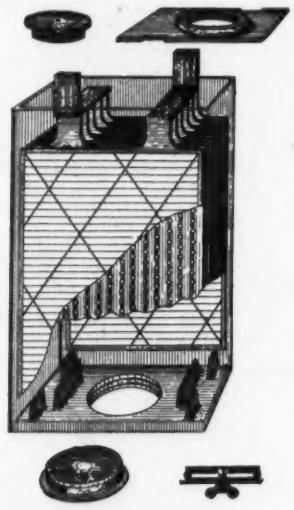


FIG. 2.—A WASHABLE CELL.

Company, of 1241 State Street, Chicago, Ill., is the manufacturer of this storage battery, which is called the Duntley "Washable Cell."

An Electrical Typewriter.

An electrical typewriter has been put on the market by the Blickensderfer Manufacturing Company, of Stamford, Conn. The machine is operated by a 1/32-hp, 110-120-volt, direct-current Diehl motor. By pressing the key, contact is made which operates a clutch. This clutch operates a driving bail which draws the type to the paper. The advantages claimed for the electric typewriter are many. In ordinary machines the operator must supply the power that makes the impression. On the electric machine the mere weight of the finger on the key makes the full depression of about one-eighth of an inch. At this point the electric power takes control of the mechanism. Another feature is the automatic key release, which enables the operator to strike one key before the preceding one has been released, adding great speed and ease.

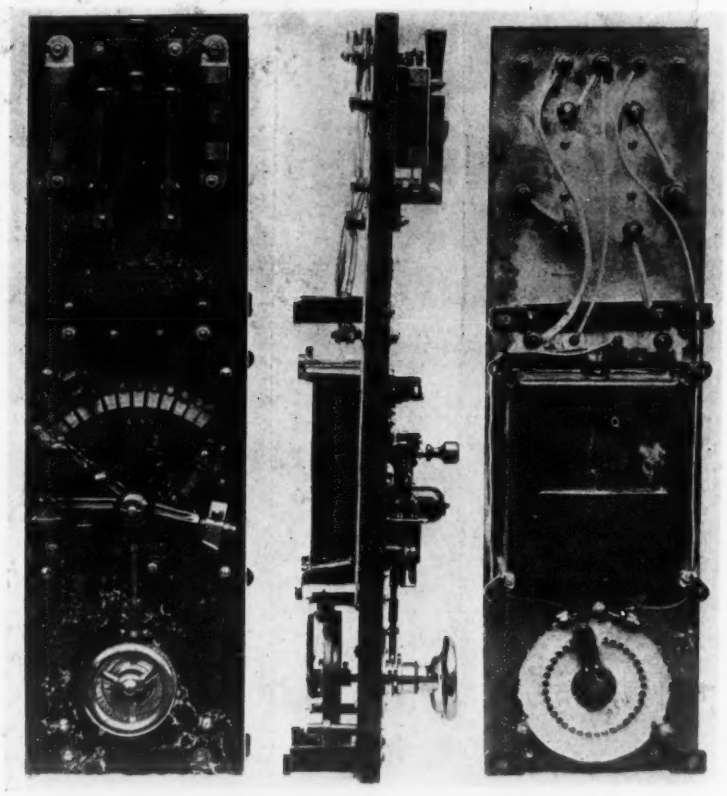
The machine has also automatic line spacing. On other typewriters the operator, on reaching the end of the line, must draw the carriage to the right against the tension of a heavy spring. On the electric machine when a line is finished, a key is simply touched and the carriage returns into position for the next line automatically; the same movement providing the space between lines. The carriage is under perfect control of the operator from the keyboard and can be moved in either direction by simply depressing a key. The operator's hands need never leave the keyboard except to place the paper in the machine. On the ordinary typewriter it is necessary to adjust the carriage for a number of copies in order to preserve the alignment and the operator must strike the keys with greatly increased

ELECTRICAL TYPEWRITER.

force to get good copies. On the electrical machine the alignment is permanent for any number of copies and the operator uses the same light touch as for one copy only. Other advantages include automatic tabulating, automatic ruling and underscoring, interchangeable carriage rolls and practically unlimited speed.

A New Rheostat Panel.

The Ward Leonard Electric Company, Bronxville, N. Y., has brought out the United States Government panel shown in the cut, which meets the very complete specifications of the United States Government which have been prepared to cover controller panels. These panels are for use in controlling variable-speed motors, speed variation being obtained by varying the field strength of the motor. Besides the features of a complete panel, enclosed moisture-proof resistance, interlocking device, preventing the motor being started under conditions of weakened field, overload circuit-breaker, protecting the motor at all times, and no-voltage release



VIEWS OF RHEOSTAT PANEL.

magnet independent of the field strength, this cut shows the new and improved quick-make and quick-break device with magnetic blow-out upon the motor-starter, which prevents detrimental arcing at the first live contact. The cut also shows a starting arc, equipped with renewable, self-aligning contact shoes, and contacts of the starter not only removable, but slightly raised from the slate face to prevent short-circuiting of the same due to the filling in of the space between the segments by metallic chips, etc.

Electrical Exhibits at the World's Fair.

Both the electrical and air brake departments of the National Electric Company, of Milwaukee, Wis., are adequitely represented in the exhibit which is in the northwest corner of the Electricity Building and under the traveling crane. A handsome office booth is in the center of the block and is surmounted by a flasher sign. The conveniences of a traveling crane for construction work were in evidence in this space, as the carpenters did all their work on the floor, and the pillars, cornice and roof of the booth were placed by the crane. The largest exhibit item is an engine type 400-kw generator. A 150-kw, 550-volt generator is belt-driven by a 20-hp, 220-volt motor. A 3,200-volt, 150-kw alternator is shown. In addition to these there is in operation a 10-kw motor-generator set and a 60-kw, 550-volt, direct-current generator belted to a 30-hp, 220-volt motor. It might be mentioned that this company has in the central power station a 1,500-kw, 6,600-volt, three-phase, 25-cycle alternator. There is a three-car train equipment of Christensen multiple-unit air brakes, such as are used on the South Side Elevated Railway, in Chicago, the Boston Elevated, and the Intramural Railway, in the Exposition Grounds. The company has "school" or "practice" equipments of air brakes, which enable motormen to be instructed regarding the functions and manner of operation of air brakes on the cars. One of these, electrically-driven, is in operation. Another motor-driven air outfit, which is very useful about electrical machinery, consists of a portable cleaning set, with a capacity of 22 cu. ft. of free air per minute. This is used for cleaning generators, railway motors and electrical apparatus, subject to carbon and copper dust. It has been found that employing this air blast to keep the machinery constantly clean prolongs its life about one-third. There is also shown a stationary compressor with a capacity of 75 cu. ft. of free air per minute, such as is employed by railway companies and power houses for car-cleaning purposes and in repair shops for air hoists and pneumatic tools.

About the space of the Safety Insulated Wire & Cable Company is a railing made of sections of armored cable, and within are samples of wires for every electrical purpose. There are chunks of Para rubber just as it comes from Brazil to be used in preparing the insulating covering to the wires or cables. Apparatus for laying submarine cables is displayed. The transparencies giving views of placing deep-sea cables are very interesting. The greater part of the company's participation in the Exposition is hidden in the conduits underground. There are about 600 miles of wire used for power, light and communication about the World's Fair and of this the Safety Insulated Wire & Cable Company furnished a large part.

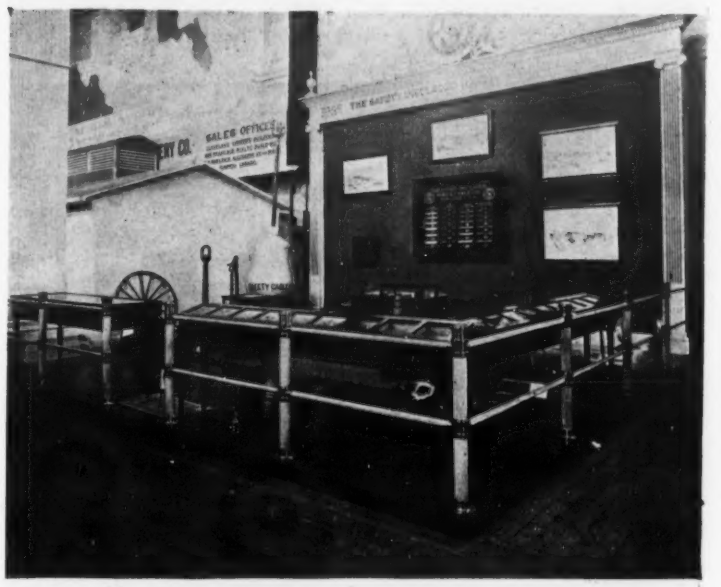


FIG. 2.—EXHIBIT OF SAFETY INSULATED WIRE AND CABLE COMPANY.

The exhibit of the National Cash Register Company in the Electricity Building is the first ever made of electrically-equipped registers. None of these machines have ever been placed on the market, and it will be a surprise to many to learn of the possibilities of electricity applied to registers. Two registers of latest model are operated by electricity, giving a complete demonstration of machines in actual use, while another register is operated by a life-sized wax figure. Practical applications of electricity are demonstrated by a distance indicator, by means of which a register operated in one place gives an indication of an operation wherever the electrical indicator may be situated, no matter how far distant. A new checking system operated by electricity is displayed here for the

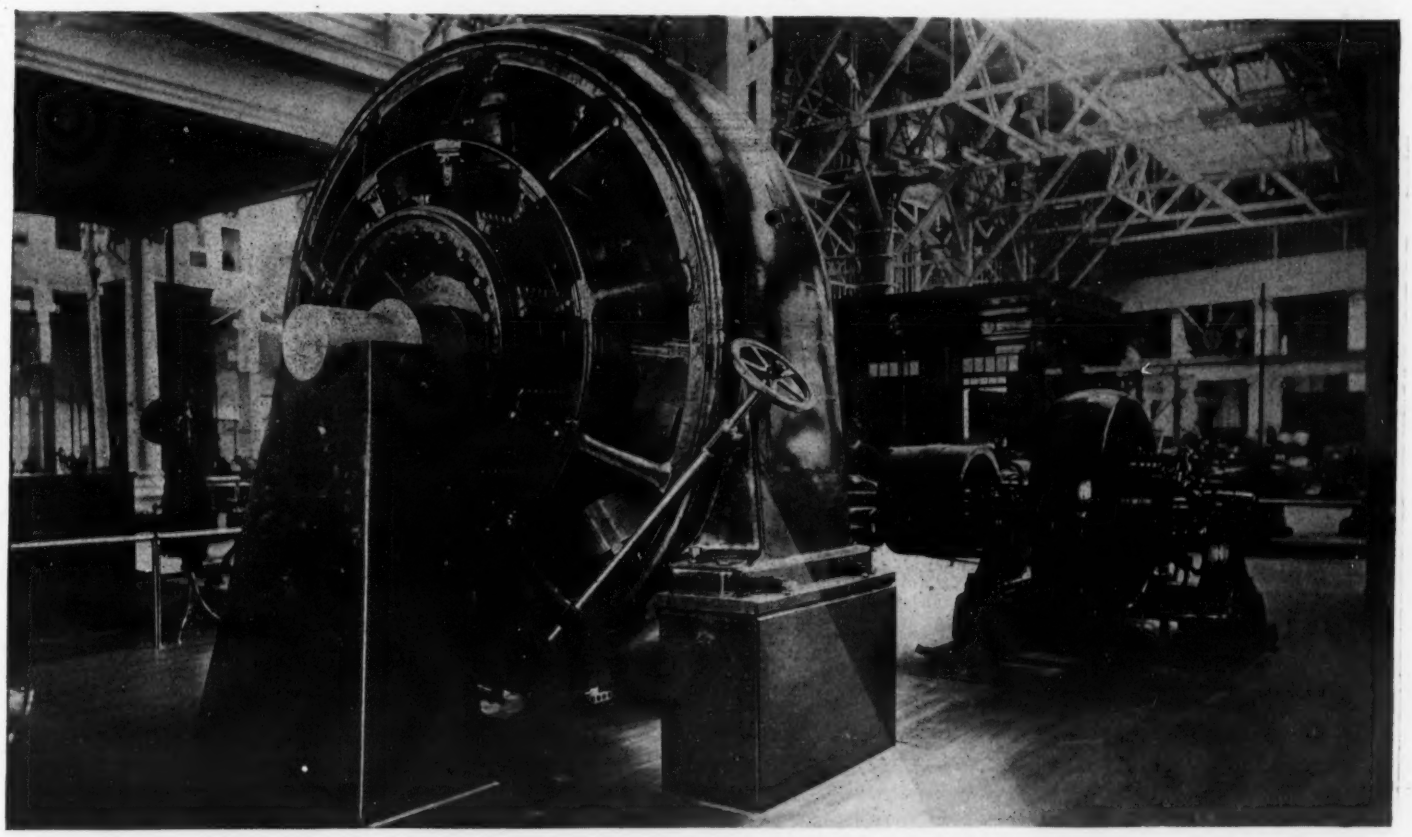


FIG. 1.—NATIONAL ELECTRIC COMPANY'S EXHIBIT.

first time. A series of beautifully colored transparencies form an interesting part of this display, and show the extensive modern electrical power and light equipment at the Dayton factory, such as generators, dynamos, tunnels, etc., as the factory is operated entirely by electricity from a central power house. In the Liberal Arts Building is the main exhibit, and there a full line of the company's registers are displayed. The Educational Building exhibit is devoted particularly to showing the welfare work among the 5,000 employees of the company. In the Varied Industries Building an auditorium has been built for stereopticon lectures. All of the booths are finished exteriorly in old ivory effect, while the interiors are decorated in green, with woodwork of quartered oak. Besides these four exhibits, the company shipped over 600 registers to the World's Fair to be used in checking receipts of concessionaires on the grounds.

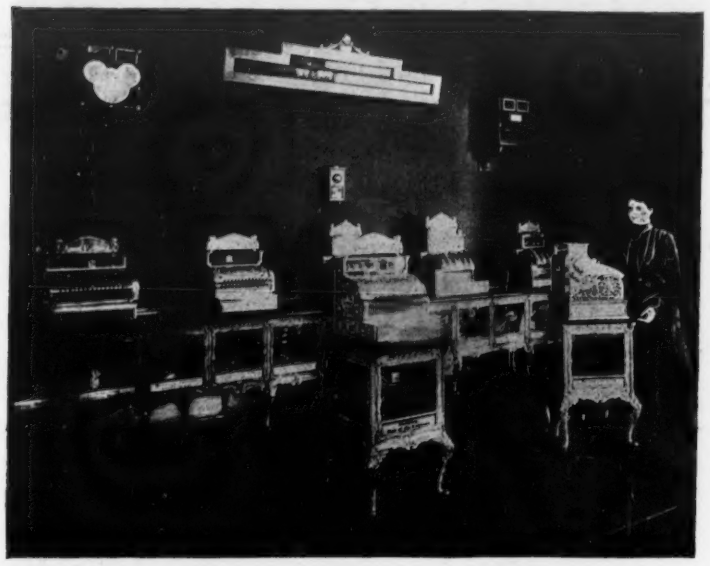


FIG. 3.—EXHIBIT OF NATIONAL CASH REGISTER COMPANY.

One of the earliest and largest static machines made is shown by the University of Mississippi in the electrotherapeutic section of the Electricity Building. No better description can be given than that in "Silliman's Physics." "The largest electrical machine hitherto constructed, as far as we are advised, is that made for the University of Mississippi, at Oxford, under the direction of President F. A. P. Barnard, by Ritchie, of Boston, in 1857. This machine has two plates of French glass, each six feet in diameter, sustained by an insulated steel axle, upon eight cut-glass supports on a frame of rosewood. The plates are excited by four pairs of rubbers, made of brass and lined with fine wool felt three-eighths of an inch thick, such as is used for the dampers of the grand piano. These are covered with firm India silk, upon which the amalgam is spread. Rubbers of this construction are found to be far more efficient than those in general use. The prime conductors of this machine expose 50 sq. ft. of polished brass cylinders in three sections, about one foot in diameter by seven in length, sustained also on cut-glass insulating pillars. One turn of this machine fills the apartment with an overpowering odor of ozone. It is so arranged as to afford negative electricity from four rubbers. One battery for this machine contains 120 glass bells, arranged in detachments, whose coated surfaces expose about 90 sq. ft. of area."

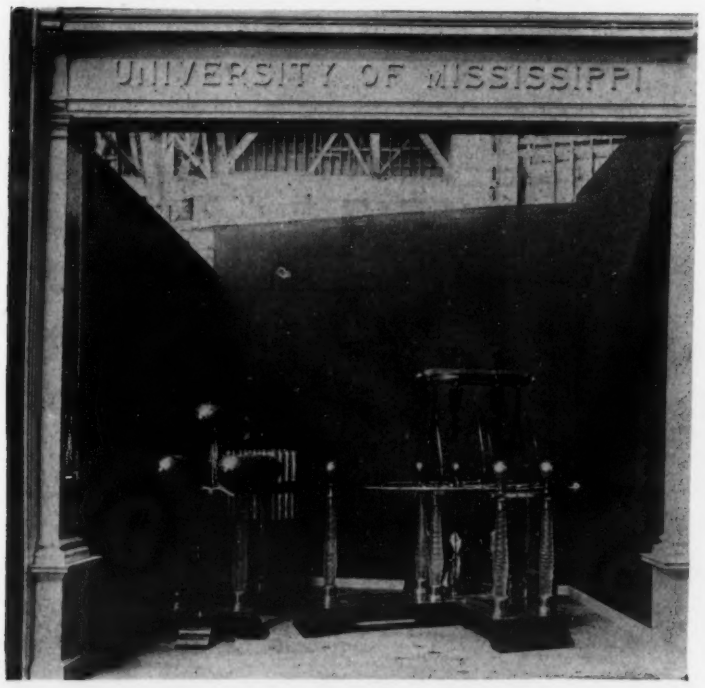


FIG. 4.—EXHIBIT OF UNIVERSITY OF MISSISSIPPI.

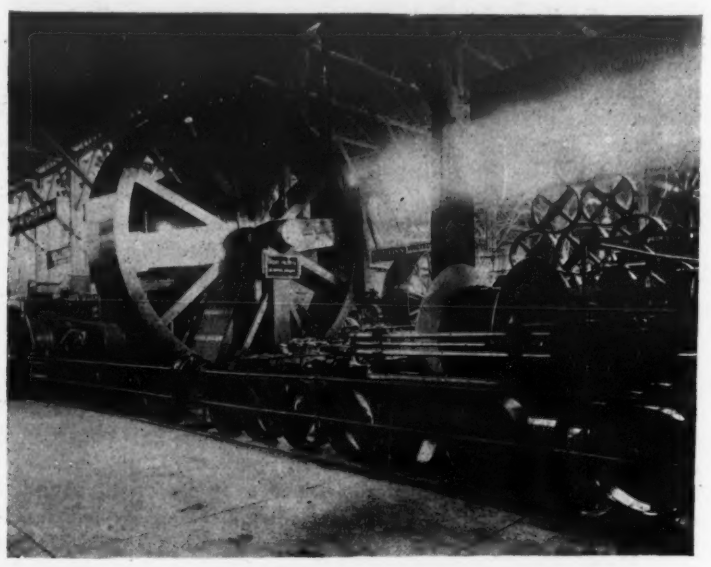


FIG. 5.—EXHIBIT OF REEVES PULLEYS.

The conspicuous feature of the Reeves Pulley Company's exhibit is an enormous revolving wheel, which can be seen from all parts of the Machinery Building. This great wooden wheel is slowly rotating without visible means of propulsion and on this account as well as its size attracts the interest of many visitors. The Reeves wood split pulleys are built of wooden segments nailed and glued and the two halves of the wheel are held together by compression bolts. The standard sizes range from 1 in. to 32 ft. in diameter. Another feature of the exhibit is a variable-speed transmission, which consists of a frame holding the driving and driven shafts. Upon each shaft is a pair of cone-shaped discs with apexes facing and spline-mounted. A V-shaped link belt connects the two. By varying the distance apart of the discs the speed may be changed by very small graduations within the limit of the apparatus.

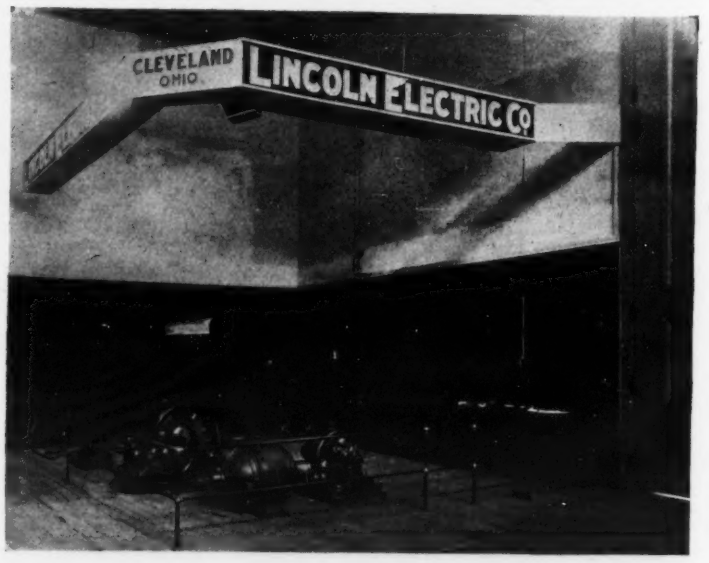


FIG. 6.—EXHIBIT OF LINCOLN ELECTRIC COMPANY.

The Lincoln Electric Company, of Cleveland, Ohio, exhibits several standard alternating and direct-current dynamos and motors.

A direct-current, variable-speed motor is shown having a variation from 500 to 3,000 r.p.m., and designed to receive power from an ordinary two-wire circuit. The interesting feature of the exhibit is a new solenoid giving a long, even stroke with very great pull. The application of this solenoid to an electric mine door is shown in constant operation. An arc lamp is introduced having but one moving piece in it, and employing the principle used in the solenoid to give an even pull through a long distance.

The Economical Electric Lamp Company has an attractive booth decorated with "turndown" lamps made by this company. An automatic figure demonstrates the operation of the lamps, and another lamp is equipped with an indicating meter to show the saving of current effected by the use of a small filament. The "turndown" lamp is identical with the ordinary incandescent lamp, but in connection therewith has a small filament which enables the user to change the lamp from one degree of brilliancy to another. The "pull-string" lamp is fitted with a switch operated by two pendant cords, which may be of any length desired. By pulling the string to which a disc is attached, the lamp is lighted to its full capacity. By pulling the other string, the light is reduced to one candle-power.

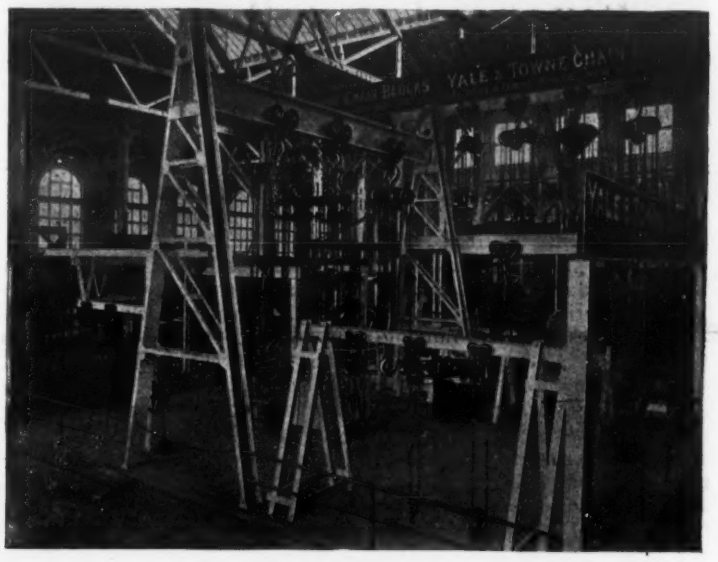
FIG. 7.—BOOTHS OF ECONOMICAL ELECTRIC LAMP COMPANY AND ELECTRIC CONTRACT COMPANY.

This "turndown" lamp is now used in sick rooms, sleeping rooms, bathrooms, halls, or wherever a small light is at times required, which can instantly be changed at will to one of full power. The fact that the lamp fits all standard sockets makes it applicable wherever electricity is used.

The St. Louis Yale & Towne Exhibit.

One of the exhibits interesting to the mechanical and electrical engineer at St. Louis is that of the Yale & Towne Manufacturing Company in Machinery Hall. The company shows in the space herewith illustrated hoisting blocks of all three types, from one-eighth to 20 tons capacity, and the most striking part of the exhibit is that inclusive of moving hoists. The new electric hoist referred to later is shown, as well as the triplex, duplex and differential blocks operated by means of electric motor for the purpose of showing their efficiency. Each block is supplied with a 1,000-pound weight and the arrangement is such that equal power is applied to each block. The mechanism is automatic, so that when the triplex weight arrives at the top all three blocks reverse their motion and lower the weights until all reach the floor, when they again reverse and start the hoist. This plan shows at a glance the relative efficiencies of the blocks, and is of particular interest to any engineer.

The new Yale & Towne electric hoist is designed to meet the growing demand for a simple, convenient and durable power hoist. It is made to withstand the roughest usage and give satisfactory service in the hands of the inexperienced workman. It may be moved from one place to another as easily as a chain block, and used in any part of the works or yards where current is available. It greatly increases the efficiency of any hand crane, and its compactness enables it to be hung up and operated in the smallest space. The material throughout is the best and all parts are made to gauge for



YALE & TOWNE CHAIN BLOCK EXHIBIT, MACHINERY HALL.

interchangeability. The motor is placed above the oil-submerged parts of the hoist and the motor shaft bearings prevent the oil entering the motor. The oiling devices preclude heating from overload, or injury from the high temperatures usually existing near the ceiling. The load is taken on wire hoisting rope of the toughest steel, wound on grooved drums that are keyed direct to the main shaft. At the bottom the steel hoisting rope passes around an equalizing sheave, thereby balancing the strain. All parts under tension or subjected to transverse strain are of forged steel or wrought iron. The hoist always balances properly on its single upper hook whether loaded or empty, and pulls in a true vertical line throughout the lift. The single swivel hook suspension allows it to pull as well at any angle. The working parts are enclosed in an oil-tight iron casing, which excludes the dust and water, at the same time insuring thorough lubrication. The load cannot run away even should the motor or brake become inoperative; an automatic cut-off prevents the load from being hoisted too high.

The hoist is operated from the floor and is regularly equipped with a telescoping controller rod, enabling the workman to control it from a point in full view of his work without depending on signals to a crane operator. Pendant cords or chains are furnished if preferred, but the rod-controlling device gives more accurate control of the load and is so made that it cannot catch on any obstruction and start the hoist when traversing a crane or runway.

The Big Engine at The St. Louis Exposition.

The central feature of the machinery exhibits at the World's Fair in St. Louis is the huge Allis-Chalmers engine, coupled to a Bullock Electric generator. This colossal unit is the most powerful ever placed on exhibition. The engine is capable of developing 3,000 hp when operating condensing, at 150 pounds pressure of steam, and running at 75 r.p.m. But it is not merely a display feature; it furnishes the electric current for the now world-famous decorative lighting of the buildings and grounds, for which about 200,000 incandescent lamps are required. The exhibition authorities frequently employ it for other purposes as well, sometimes for operating the Cascades and sometimes for general power purposes. Recently it was suddenly called upon to take the entire load ordinarily carried during the day by a large plant in the same building, and aggregating about 5,400 hp. Having carried this load as long as it was needed, the Allis-Chalmers giant then took up the regular lighting work for the evening. This engine and generator have been constantly ready for any emergency from the beginning, and have never failed to respond immediately and with complete satisfaction whenever called upon. The engine has worked perfectly ever since the steam was first admitted to its cylinders, and it is popularly known among the exhibition people as "Big Reliable."

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—The stock market was strong and prices were higher, reflecting increased confidence of financial interests, and hopeful views respecting crops and business. Standard railroad shares and the Steel issues were the objects of considerable buying, at advanced prices, and the market closed with a strong undertone. The industrials, without attracting much attention, were strong in tone, and on Friday Amalgamated Copper advanced to 51½, apparently on manipulation. The Metropolitan Street Railway group was again decidedly strong, while Brooklyn Rapid Transit was heavy. Sales of the former stock aggregated 114,100 shares, at prices ranging from 114½ to 118, the closing figure being 116¾, a net gain of 2⅜ points. In Brooklyn Rapid Transit 106,110 shares were sold, the closing price being 50⅝, a net gain of 1⅛. The electrical industrial issues were all higher, Allis-Chalmers closing at 44, being a net gain of 1½; General Electric at 153¾, a gain of 1¾, and Westinghouse 158, a gain of 1 point. American Telephone & Telegraph kept steady at 129 throughout the week, while Western Union made a net gain of 1⅛ points, closing at 88. The curb market for outside securities reflected the conditions of the main market, but transactions were, as a rule, small. Among the features was Interborough Rapid Transit, which advanced 4 points. The money market was easy as a whole, though slightly firmer in speculative lines. Call money closed at 1 per cent., and 60-day loans 3½ to 4 per cent. Following are the closing stock quotations of July 12:

NEW YORK

	July 5	July 12		July 5	July 12
Allis-Chalmers Co.	9	8¾	Electric Vehicle	8⅛	9¼
Allis-Chalmers Co. pfd.	42¾	43½	Electric Vehicle pfd.	12	13
American Tel. & Cable.	89	89	General Electric	158	158⅛
American Tel. & Tel.	129	128¾	Hudson River Tel.	..	..
American Dist. Tel.	22	23	Metropolitan St. Ry.	115	115⅞
Brooklyn Rapid Transit.	49¾	50¼	N. Y. & N. J Tel.	..	..
Commercial Cable.	175	178	Marconi Tel.	..	..
Electric Boat.	48	41	Western Union Tel.	87¾	87
Electric Boat pfd.	75	74	Westinghouse com.	156	157
Electric Lead Reduction.	*⅜	¼	Westinghouse pfd	180	180

BOSTON

	July 5	July 12		July 5	July 12
American Tel. & Tel.	129	128⅛	Western Tel. & Tel. pfd.	81	81
Cumberland Telephone.	112¾	113¾	Mexican Telephone.	*1⅛	*1⅜
Edison Elec. Illum.	*245	249½	New England Telephone.	121	121
General Electric	156	..	Mass. Elec. Ry.	19¾	19⅝
Western Tel. & Tel.	9¼	9¼	Mass. Elec Ry. pfd.	72	73¾

PHILADELPHIA.

	July 5	July 12		July 5	July 12
American Railways.	45⅛	45⅛	Phila. Traction.	97¾	98
Elec. Storage Battery.	57	57	Phila. Electric.	5¾	6
Elec. Storage Battery pfd.	57	57	Phila. Rapid Trans.	11¾	11¾
Elec. Co. of America.	8⅞	8			

CHICAGO

	July 5	July 12		July 5	July 12
Central Union Tel.	..	..	National Carbon pfd.	101	101½
Chicago Edison.	142	144	Metropolitan Elev. com.	18⅜	19⅛
Chicago City Ry.	168	168	Union Traction.	5	4
Chicago Tel. Co.	122	120	Union Traction pfd.	25	26
National Carbon.	..	28½			

*Asked

WESTERN UNION LOSSES.—Discussing the effect of the loss of poolroom business by the Western Union, the *Wall Street Journal* says: "The April-May-June quarter is usually the busiest of the racing season. The net revenue, therefore, for the quarter just closed will be compared with that of the same quarter of 1903 by many critical eyes. The company's official estimate for the quarter ending June 30, 1904, is $1,850,000, as compared with $2,007,698 in 1903, a loss of $157,698, or nearly 8 per cent. It is thought that the official estimate is not far wide of the mark for the quarter just ending, but the impression that the net revenue for this quarter can be used as a basis for determining the annual loss is misleading. When the directors suddenly stopped the direct poolroom service it demoralized the poolroom keepers. For some time they flooded the race tracks with messages at commercial rates, taxing the facilities of these Western Union offices to the fullest extent. Gradually, however, by reason of telephone combinations, the volume of track business has contracted, and recently it has resumed nearly normal proportions, a fact which points to a considerably reduced net revenue for the next quarter, ending September 30, 1904. Consequently, it will be seen that while the net revenue loss for the present quarter is not quite 8 per cent., the amount may be largely increased when the poolroom men perfect their new system of collecting and disseminating racing news. The Western Union's profits for the year ending June 30, 1903, were $8,214,471. Its dividend charges were $4,868,050, and its interest and sinking fund charges were $1,077,700. According to these figures, should the loss in net income reach even one and a half millions, or 20 per cent., the company would still earn nearly a million dollars more than is needed to pay its fixed charges and a 5 per cent. annual dividend."

OTTAWA ELECTRIC ANNUAL REPORT.—President T. Ahearn makes a pleasing annual report, as of April 30, for the Ottawa Electric Company. The gross earnings from all sources aggregated $211,683.28. The installations show additions for the year of 12,524 incandescent lights, 99 arc lights, 23 power motors, with 616 additional customers. The expenses, of $138,378.03, show an increase of $18,678.53, leaving a gross profit of $73,305.25. The regular branches of expenditure have remained practically the same. The increase is accounted for by work of a special character in the nature of permanent improvements, and includes the re-building of the company's lines destroyed by the disastrous fires of May 10 and June 4, 1903, the re-construction of the main switchboard, etc. The cost of all this work was charged to expense account. The sum of $28,673.10 was expended upon capital account during the year for power house apparatus, extension of service lines and accessories. The expense of management, operation and maintenance, together with bond and bank interest, deducted from the gross revenue, leaves a net profit for the year of $47,734.36, which has been carried to the credit of profit and loss account. The balance standing at credit of profit and loss account last year was $24,417.27, which with the addition of the profit for the present year amounts to $72,151.63, from which the directors, after providing for bad and doubtful accounts, have placed $25,000 to the credit of rest account.

SALE OF WESTCHESTER LIGHTING.—An announcement of the purchase of the Westchester Lighting Company, which controls the electric lighting and gas lighting of a large portion of Westchester County, by the Consolidated Gas Company, is made, as it is understood that negotiations have been practically completed. The Westchester Company is capitalized at $12,500,000, $2,500,000 of this being 6 per cent. preferred stock. It has $3,999,000 of first mortgage 5 per cent. bonds. The Westchester Company was organized by the United Gas Improvement Company, of Philadelphia, and among the cities which it serves are Yonkers, New Rochelle, Mount Vernon, Pelham and White Plains. It owns valuable franchises, and its business has steadily increased with the development of Westchester County.

Commercial Intelligence.

THE WEEK IN TRADE.—Trade and industry were at a low ebb as a result of summer shut-downs, vacation influences and generally quiet distributive demand. The crop situation naturally commands chief attention, and the irregular movements of securities and of prices of staples are traceable to the uncertainty as to the condition of the crops. Reports from cotton and oats are, however, favorable. Larger total bank clearings, according to *Bradstreet's*, reflect increased activity in speculation and mid-year dividend payments. Earlier reports of good June railway earnings are confirmed, and the increase in gross earnings will probably be 3 per cent. Collections show practically no change, and are classed as fair, generally. As to the crop situation, *Bradstreet's* reports indicate that there is too much rain for the winter wheat crop, from Texas to Nebraska. East of the Mississippi, however, winter wheat reports continue favorable, except in the Ohio valley, where no improvement is noted. On the same subject, *Dun's Review* states that the total yield of all crops promises to be large unless future weather conditions are much worse than average. The indications are that there will be a good yield of corn, though tardy, and cotton reports are unusually encouraging. Quiet generally ruled in all the leading industries. Production of crude materials is down to a minimum in iron and steel, and while there is more inquiry, manufacturers are reluctant to sell at present low prices. The steel rail mills, it is stated, have booked about half of their possible output, but for the rest of the year the outlook is uncertain. Lumber trade is quiet as a whole. The copper market was quiet, but a fair export business was transacted. The shipments to Europe during June aggregated about 16,000 tons. The closing quotations were 12¼ to 12½c. for Lake, 12⅛ to 12⅜c. for electrolytic, 11⅞ to 12½c. for cathodes and 12c. for casting stock. *Bradstreet's* reports 172 business failures during the week ending July 7, against 204 the week previous, and 154 the corresponding week last year.

NEW YORK ELECTRIC CAB RATES.—A reduction has been made by the New York Transportation Company in electric cab rates. The mileage rate has been reduced from 50 cents to 40 cents per mile or fraction for a single brougham, and 50 cents per mile or fraction for an extension brougham, carrying three or four people. A hansom also costs 50 cents per mile, while the highest mileage rate is that charged for a victoria or surrey—75 cents per mile. The waiting rates are 50 cents per half hour or fraction thereof for any of the above-named vehicles except the hansom, the waiting charge for this being 50 cents per hour or fraction. The hourly rates, which apply to shopping trips, making calls or other service where there are numerous short stops, are $1 per hour or fraction thereof for single brougham, $1.30 for a hansom or extension brougham, and $2 for a victoria or surrey. This class of rates applies only in the district between Eighty-seventh Street and Washington Square, including the Christopher Street Ferry. This covers an area about five miles long and two miles wide, and embraces all the principal retail stores and a large and fashionable residential section. If these boundaries are crossed, regular mileage charges are added while the vehicle is out of the prescribed district. The reduced rates will not be in force between the hours of 1 p.m. and 6 p.m., when the old charges will apply. The reason for this is that the company has all the business it can handle, with the present equipment, during that part of the day. To be taken to the theatre in a hansom, brougham or extension brougham, and brought home again afterward, costs $2.50 as long as the trip is in the district below Seventy-fifth Street and above the Christopher Street Ferry. A single brougham can be hired to go to Coney Island and return, about 28 miles altogether, for $10, or a hansom or extension brougham for $12, and the same rates apply to the trip to and from the Morris Park race track, a total distance of 29½ miles, which include waiting for the conclusion.

SIGNIFICANT EXPORT FIGURES.—Manufactures and manufacturers' materials form an unusually important factor in the figures of American commerce during the month of May, and, indeed, in those of the entire fiscal year. For the first time in the history of our foreign trade the value of manufactures exported during the month of May exceeded that of agricultural products. The total value of manufactures exported in May, 1904, was $38,894,561, against $37,891,838, the value of agricultural products exported. Ordinarily the value of agricultural exports is more than twice as great as that of manufactures exported. There has been but one complete fiscal year in the history of our export trade in which the total exports of manufactures were even half as great as the total of agricultural products. In 1900 the value of manufactures exported was $433,851,756 and of agricultural products, $835,858,123, so that in that particular year the value of manufactures exported was a little more than one-half that of agricultural products, but never before had manufactures equalled or exceeded the value of agricultural products in our figures of domestic exports. This preponderance of manufactures in the exports does not by any means hold good for the entire fiscal year, the total of manufactures exported during the eleven months ended with May, 1904, being but little more than half the total of agricultural exports, but in the single month of May manufactures exported actually exceeded agricultural products exported by over $1,000,000.

ORDERS FOR VILTER ENGINES.—The Vilter Manufacturing Company, Milwaukee, Wis., builder of engines, refrigerating and ice-making machinery, Corliss engines, brewers' and bottlers' machinery, has recently closed contracts for a large number of ice and refrigerating plants. They have also taken contracts as follows for engines: Western Portland Cement Company, Yankton, S. D., 18 x 36 Corliss engine; P. M. Smith (Crystal Ice Company), Wellsville, O., 18 x 36 Corliss engine; Boland & Gschwind Company, Ltd., New Orleans, La. (for customer), 15 x 36 Corliss engine; Boland & Gschwind Company, Ltd. (for customer), 18 x 36 Corliss engine; Horlick Food Company, Racine, Wis., two 22 x 42 Corliss engines; Woodmanse Manufacturing Company, Freeport, Ill., 16 x 36 Corliss engine; Independent Milwaukee Brewery, Milwaukee, Wis., 18 x 36 Corliss engine; John Hoberg Company, Green Bay, Wis., 18 x 36 Corliss engine.

ACTIVITY IN COPPER.—Senator Clark, of Montana and New York, who arrived here on the White Star liner Teutonic, says of the use of copper abroad and the condition of copper production in this country: "Germany will use great quantities of American copper during the next five or six years. She is already making a large proportion of the small arms being used by Russia in her war in the Far East. American copper is being used in this work. Soon Germany will be manufacturing an equally large part of the Japanese small arms. The outlook for copper is splendid. It never has been finer. Things are going to hum for the next half a dozen years at least. The American exports of copper will increase to a marked extent, and that will be a fine thing for the country."

THE CROCKER-WHEELER COMPANY has formally announced what for some time has been quite generally known, that by arrangement with Brown, Boveri & Cie., of Baden, Switzerland, it has secured their alternating-current designs, patents and rights to manufacture in America, and has retained them as consulting engineers. The Crocker-Wheeler Company further announces that it is now putting on the market alternating-current generators, transformers and accessories of the most perfect design and construction, adapted to American practice. A contract has been closed for a 200-kw, 60-cycle, 440-volt, alternating-current generator, for the Atlanta plant of the Procter & Gamble Company, Cincinnati.

WESTINGHOUSE STEAM TURBINES FOR SOUTH AFRICA.—The DeBeers Mines Company, Ltd., Kimberly, South Africa, has cabled an order for a third Westinghouse-Parsons steam turbine generating outfit of 1,500 kw capacity for its power plant at Kimberly. The new turbine unit will be similar in every respect to the two which have been in operation for somewhat over a year. It will operate at 150 pounds, boiler pressure, 35° superheat and about 23-in. vacuum. Taking into account the altitude of Kimberly, this would be equivalent to about 27-in. vacuum at sea level. The new unit will be shipped via New York in about six months.

1,000-HP EQUIPMENT FOR SOUTHERN COTTON MILLS.—The Revel Manufacturing Company, of Greenboro, N. C., has placed an interesting contract for equipment in an extension of its cotton mills. The machinery will include a 1,000-hp cross-compound, heavy-duty horizontal condensing engine, to be built by the Hooven, Owens & Rentschler Company, of Hamilton, Ohio, New York offices under the management of Mr. W. B. Mayo, 39 Cortlandt Street. The engine is to be direct-connected to a generator of General Electric build and of 650-kw capacity.

GENERAL ELECTRIC EQUIPMENT FOR LARGEST SUGAR FACTORY IN WORLD.—The Colonial Sugars Company, Mr. M. R. Spelman, of 33 Wall Street, president, has placed the contract for the electrical equipment for its huge sugar factory on the Constancia plantation, near Cienfuegos, Cuba, with the General Electric Company. Electrical machinery will be utilized for driving the centrifugals and for operating the cranes, which will unload some 5,000 tons of cane daily during the season, and for lighting the plant.

2,000-HP PLANT FOR CARNEGIE INSTITUTE.—Contracts are about to be let for considerable equipment to be installed in the Carnegie Institute at Schenley Park, Pittsburg. There will be a 2,000-hp plant put in. The machinery will comprise five 400-hp engines direct-connected to generators of 250-kw capacity each. Clark & MacMullen, the consulting and electrical engineers, of 20 Broad Street, New York City, are acting in the matter.

MORE EQUIPMENT FOR BARBOUR FLAX MILLS.—The Barbour Flax Spinning Company has ordered a 900-hp Wetherill cross-compound condensing engine for direct-connection to a Crocker-Wheeler generator of 600-kw capacity for installation in its mills at Paterson, N. J. A number of Crocker-Wheeler motors, as recently recorded in these columns, will also be furnished.

EQUIPMENT FOR UPTOWN APARTMENT HOTEL.—A large apartment hotel is to be built between Seventy-third and Seventy-fourth Streets and Central Park, which will have a good-sized electrical plant. Clinton & Russell, of 32 Nassau Street, New York, are the architects. The equipment, it is expected, will include a 600-hp engine direct-connected to a 400-kw generator.

EQUIPMENT FOR NEW SCHIEREN LEATHER FACTORY.—Contracts have been awarded for the equipment to be installed in the new extension of the leather factory of Charles A. Schieren & Co. The engines will be built by the Watertown (N. Y.) Engine Company. The order for the generators went to the General Electric Company.

LIGHTING AND TELEPHONE SYSTEM FOR JIMENEZ, MEXICO.—Mexican advices state that the contract for the installation of an electric lighting and telephone system in Jiminez, State of Chihuahua, has been awarded to Weisel & Kok, of Parral, Mexico.

DRILLS FOR MEXICAN COPPER MINES.—The Marvin Electric Drill Company, of Binghamton, N. Y., will ship some thirty electric drilling equipments to Mexico for use in the Yagui Copper Company's property at Campo Santo Nino, State of Sonora.

CINCINNATI ELECTRICAL TOOLS FOR ABROAD.—The Cincinnati (Ohio) Electrical Tool Company contemplates the enlargement of its manufacturing facilities. Last month nearly 50 machines were exported to various parts of the world.

EQUIPMENT FOR CARRIZAL MINES.—Mr. Rudolf J. Decker, of Salt Lake City, Utah, has been awarded the contract for the electrical equipment to be installed in the Carrizal Gold Mining Company's property, State of Michoacon, Mexico.

General News.

THE TELEPHONE.

PRATT CITY, ALA.—The Southern Bell Telephone Company is making extensive improvements at Pratt City in addition to installing a new switchboard.

LOS ANGELES, CAL.—The Home Telephone Company is building a large central station at Glendale for the district including Glendale, West and North Glendale, Tropico, Ivanhoe, Eagle Rock, Burbank and Toluca.

LOS ANGELES, CAL.—The business of the Pomona Valley Telephone Union continues to increase. About 600 subscribers are already served. The line to Spadra and Lemon is completed. Arthur M. Dole has been elected a director of the company, vice C. B. Sumner, resigned.

LAYTONVILLE, CAL.—The Pacific Telephone Company of Mendocino County will extend its system from Sherwood to Layton, thus connecting with the new terminal of the Sunset Telephone Company at Willets. This will give two direct routes by wire from Laytonville to San Francisco.

LOS ANGELES, CAL.—The Sunset Telephone & Telegraph Company will build at once a system at Sawtelle, while similar service is to be canvassed for at The Palms and Playa del Rey. More than 150 new telephones have been installed in Santa Monica and Ocean Park within the last few weeks.

LOS ANGELES, CAL.—Epes Randolph is at the head of a new telephone consolidation in Arizona. The syndicate of which he is president has obtained a 25-year lease of all telephone lines in the territory, most of which had been independent enterprises. C. W. Hinchcliffe is vice-president and general manager of the new company, and he is extending new lines in every direction. The ultimate object is said to be the connection of El Paso in the east and Los Angeles in the west with Arizona cities by long-distance telephones. Mr. Randolph's headquarters are in Tucson.

TAMPA, FLA.—Directors and shareholders of the Peninsular Telephone Company, of Tampa, have laid plans for enlarging their system, which is now the most extensive in any town in Florida. It has toll lines connecting with all the principal surrounding systems and contracts with the leading lines in the state. The company expects to enlarge not only the city exchange, but to increase the facilities of its toll line by building and extending lines into surrounding territory.

ALBANY, GA.—A franchise has been granted to the Blakely Telephone Company.

BLACKSHEAR, GA.—The Southern Bell Telephone Company is making arrangements to establish a local exchange.

ATLANTA, GA.—A bill has been introduced in the Georgia legislature to place telephone companies under the supervision of the state railroad commission. About all of the other public utility corporations are already under the supervision of this commission.

CHICAGO, ILL.—Chicago Bell Telephone gained 1828 instruments during June. The total now in service is 110,712.

ARTHUR, ILL.—Davis Bros., proprietors of the Arthur Telephone Exchange, are installing a new 200-drop switchboard. They will also put up 2000 feet of cable.

MAUCHPORT, IND.—The Eureka Telephone Company has increased its capital stock from $10,000 to $25,000.

IDAVILLE, IND.—The Idaville Co-operative Telephone Company has been incorporated with a capital stock of $9000. Among the directors are T. B. Ginn and T. J. Meloin.

DES MOINES, IA.—Within two weeks the Hawkeye Telephone Company will install an exchange at Fort Des Moines, with 100 subscribers, mostly on rural lines surrounding the post.

SIOUX CITY, IA.—The Sioux City Telephone Company has had plans prepared by Wilfred W. Beach, architect, Sioux City, for a telephone exchange building to cost $25,000. Contracts will be let July 15.

TRENTON, KY.—George Mimms and others are interested in a movement to build a new telephone system at Trenton.

HOUGHTON, MICH.—The Automatic Telephone Company has applied for a franchise here.

TWO HARBORS, MINN.—Business men of Port Arthur, Ont., propose to build a telephone line from that city to Duluth, taking in all the towns along the north shore. The distance is 196 miles.

BAY ST. LOUIS, MISS.—The Citizens' Light & Telephone Company has been incorporated with a capital stock of $40,000.

ST. LOUIS, MO.—Articles of incorporation of the Suburban Telephone Company were filed in the Recorder's office in Clayton, St. Louis County, a few days ago. The capital stock is placed at $100,000. The incorporators are J. Percival Phelan, of Wellston, James D. Houseman, of Ferguson, C. R. Black, of Clayton, W. Lee Travers, of St. Louis, and H. W. Karrenbrock, of Clayton. The office of the company will be in Clayton, with Mr. Karrenbrock as its agent. The company was organized for the purpose of providing telephones for the people of St. Louis at reduced rates.

FULLERTON, NEB.—The Citizens' Telephone Company has been organized here, the capital stock being $10,000.

CORNING, N. Y.—The Hornby Telephone Company has been incorporated with a capital stock of $2000. Among the directors are W. T. Davis and H. T. Jumerson.

ALBANY, N. Y.—The Hudson River Telephone Company is making numerous extensions to the service, the underground conduits being constructed in Newburg, Middletown and Saratoga. A line is being built from Saranac Lake to Malone, and in a short time the services, which are being established by new companies in important towns in this vicinity, will be connected with the local company.

FOSTORIA, OHIO.—The West Milgrove Telephone Company has been incorporated, among the directors being J. P. De Wolf and J. C. Rhodes.

TIPPECANOE CITY, OHIO.—The Tipp Interurban Telephone Company, Tippecanoe City, has increased its capital stock from $10,000 to $30,000.

CHATHAM, OHIO.—The Chatham Farmers' Mutual Telephone Company has been incorporated with a capital stock of $100,000. The directors are W. H. Ripley, D. A. Clapp and others.

PHILADELPHIA, PA.—Keystone Telephone's net earnings for the quarter ended June 30, 1904, were $86,241, against $53,987 for the corresponding period of 1903.

ALLENTOWN, PA.—Articles of association have been filed by the Easton & Bethlehem Telephone Company, the corporation that has succeeded the New Jersey & Pennsylvania Telephone Company, the Easton Telephone Company, the Warren Telephone Company of New Jersey, and the United States Long Distance Telephone Company. The Board of Managers is composed of W. A. Wilbur, J. Davis Brodhead, Malcolm Campbell, William B. Meyers and Howard Mutchler. Mr. Brodhead is the chairman, Mr Meyers is the secretary and Mr Wilbur is the treasurer Besides those already named, the people who are financially interested in the new company include James W. Fuller, of Catasauqua, Murtha P. Quinn, of Philadelphia, Charles M. Dodson, of Bethlehem, E. P. Wilbur, R. M. Gummer, E. M. McIlvane and E. P. Wilbur, Jr., of South Bethlehem.

GREENBRIER, TENN.—The Cumberland Telephone Company will soon establish an exchange at Greenbrier, which is seven miles south of Springfield.

PORTAGE, WIS.—The Portage Telephone Company is entirely re-equipping its exchange and rebuilding the outside construction. The down-town lines are all being placed underground and the exchange will be made full metallic throughout. The apparatus is being changed from magneto to central energy and is being furnished by the International Telephone Mfg. Company, of Chicago. The exchange equipment consists of a 1200-capacity, 500-equipped lamp-line transfer board of the latest International type, together with all necessary storage batteries, charging machines, power board, battery cabinets, protective devices, etc., as well as new central energy telephones throughout. After the work is completed, the Portage Company will have one of the most thoroughly up-to-date telephone exchanges in the country.

ELECTRIC LIGHT AND POWER.

CHEROKEE, ALA.—The Cherokee Development Company, of which Henry C. Jones, of Montgomery, is chief engineer, is stated to have completed preliminary details for the construction of an immense water power plant at Cherokee Bluff, on Tallapoosa River. The plant will be built to develop 25,000 horsepower, and it is proposed to transmit this power to Birmingham, a distance of 85 miles.

MAGNOLIA, ARK.—Bids will be received at once by the Magnolia Ice & Light Company for the construction of an electric light plant at a probable cost of $25,000.

LOS ANGELES, CAL.—The city has undertaken the construction of a conduit system for electric wires. Both the Sunset and Home telephone companies are opposing the scheme.

SAN BENITO, CAL.—The San Benito Water, Light & Power Company has been incorporated by L. A. Gibbons, A. I. Little, G. T. Drinkwater and others, with a capital of $300,000.

MERCED, CAL.—The Merced Falls Gas & Electric Company is doubling the capacity of its power plant on the river. A Wagner-Bullock 225-kw generator, with exciter, has been received.

EUREKA, CAL.—The plant of the Eureka Lighting Company was completely destroyed by fire June 26, entailing a loss estimated at anywhere from $60,000 to $100,000. Over two-thirds of the town was left in darkness. The street car service was entirely suspended and power users were affected. Two years ago this month the company suffered a similar loss, the plant just destroyed being the one built to replace the property burned at that time. The property was owned by the Pacific Coast Gas & Lighting Company, and will be immediately replaced by a much larger and more substantial plant.

SAN FRANCISCO, CAL.—The contract for public lighting for the year beginning July 1 has been awarded to the San Francisco Gas & Electric Company for $320,000. It provides for 1112 arc lamps, 5335 Welsbach gas lamps, the illumination of the dome of the City Hall on twelve nights, to be designated by the Supervisors, the lighting of all public buildings except park and school buildings, and the furnishing of power for elevators. Deductions will be made for lights not burning, at the rate of 8 cents a night for gas and 35 cents for electric arcs. The company agrees to install 100 new arc lamps as directed. The rates paid will be 35 5-7 cents for each electric lamp.

HARTFORD, CONN.—The directors of the Hartford Electric Light Company have decided to construct a new power plant at Dutch Point, which will contain a complete steam equipment.

LAKEVILLE, CONN.—The electric light plant of the Hotchkiss school was destroyed by fire on the night of July 1, entailing a loss of $15,000. The property was covered by insurance. Lightning is supposed to have caused the fire. The plant will be rebuilt at once.

NORWICH, CONN.—The gas and electric light plant in this place is now under the control of the city authorities, the transfer having been made June 30. The city paid the Norwich Gas & Electric Company $190,000 for the plant. Mr. Francis S. Thayer is superintendent.

WASHINGTON, D. C.—Bids will be received July 16 by Mordecai T. Endicott, Chief of the Yards and Docks, Navy Department, for furnishing and in-

stalling two 500-kw generator sets at the navy yard here. Bids will be received July 12 at the Bureau of Supplies and Accounts, Navy Department, Washington, for furnishing at the navy yards, Kittery, Me., and Charlestown, Mass., a quantity of transformers, incandescent lamps, arc lamps, carbons, wire, conduit and fittings, switch boxes, electroliers, electrical supplies, etc. Address H. T. B. Harris, Paymaster-General, U. S. N.

LOUISVILLE, GA.—The citizens have voted to issue $10,000 in bonds for water works and an electric light plant.

LEWISTON, IDA.—E. H. Libby, of this city, is promoting the establishment of a power plant about 25 miles from here on the Grand Ronde River, at an estimated cost of $500,000. The plan is being financed by Eastern capitalists, and it is the design to supply this city and the entire Palouse country with electrical power and ultimately to construct a number of street railway systems. The plant will have a capacity of from 5000 to 10,000 horse power.

GILLESPIE, ILL.—The Gillespie Electric Light Company has been incorporated with a capital stock of $15,000. The incorporators are C. W. Smith, G. W. Schmidt, Jr., and Nettie B. Schmidt.

PARIS, ILL.—The City Gas & Electric Company, of Paris, has been incorporated with a capital stock of $150,000. The incorporators are A. J. Barber, W. J. Hunter and J. E. Parrish.

MORRISONVILLE, ILL.—The Morrisonville Electric Company, Morrisonville, has been incorporated with a capital of $6000. Incorporators: Wm. Lewis, L. D. Lewis and T. C. Cloyd.

GIBSON CITY, ILL.—The Gibson Electric Light & Power Company, of Gibson City, has been incorporated with a capital of $30,000. Incorporators: L. J. Hiland, S. L. Lefevre and A. L. Phillips.

BERN, IND.—The Bern Electric Light Company, of Bern, has been incorporated; capital, $6000. Directors: Henry H. Stucky, Samuel Simison, Fred K. Shaefer and others.

BEDFORD, MASS.—The streets of this town are now electrically lighted, the service having been inaugurated July 1.

NANTUCKET, MASS.—The property of the Nantucket Gas & Electric Company has gone into the hands of a receiver. John W. Cafley, of Boston, is treasurer and general manager of the company.

BAY ST. LOUIS, MISS.—The Citizens' Light & Telephone Company has been incorporated, the capital being $40,000.

LEBANON, MO.—The Lebanon Electric & Power Company, of Lebanon, has been incorporated. The capital stock is $2000. The stockholders are O. G. Bantley, W. P. Simpson, W. I. Diffenderffer, W. C. Faubion, C. W. Rubey, C. H. Bantley and others, all of Lebanon.

JOPLIN, MO.—Honore Palmer is inspecting the Lowell dam and power plant on Spring River, in which he is heavily interested. The project is to utilize the power of Spring River to operate mines in the Joplin district and light cities in southwestern Missouri and southeastern Kansas.

PATERSON, N. J.—The Public Service Corporation has secured the contract for lighting the city at $101 per lamp per year.

WEEHAWKEN, N. J.—The Weehawken Construction Company has secured the contract for lighting the township with electricity for a term of 30 years at $90 per lamp per year.

ADDISON, N. Y.—J. S. Hubbs, of Hammondsport, who recently purchased the electric light plant, has decided to construct a new power house.

WATKINS, N. Y.—Bids will be received July 20 by the Board of Water and Sewer Commissioners for the purchase of $20,000 electric light bonds.

ALBANY, N. Y.—The Kings County Lighting Company of Brooklyn has filed with the Secretary of State a certificate merging with it the Kings County Gas & Illuminating Company, all of whose capital stock it owned.

NEW YORK, N. Y.—Bids will be received July 19 at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., for furnishing at the New York navy yard a quantity of incandescent lamps, ventilating sets, hand control projector, motor and generator, etc. Address H. T. B. Harris, Paymaster-General, U. S. N.

OXFORD, N. C.—The town has voted for electric lights and water works. The plant will be owned by Edwin I. Frost, of Salisbury, and the town will pay $3500 annually for the service.

GRAND FORKS, N. D.—About $20,000 will be expended by the Grand Forks Gas & Electric Company for improvements.

NILES, OHIO.—The Niles Electric Company, of Niles, has been incorporated, with a capital of $10,000, by F. W. Stillwagon, W. H. Smiley, Robert Weiss and others.

CINCINNATI, OHIO.—An electric light plant at the workhouse, to cost about $10,000, is being considered by the Board of Public Service in connection with the estimates for next year, now in course of preparation.

CINCINNATI, OHIO.—Mr. Hart, a representative of the Commercial Electric Company of New Orleans, is in this city, negotiating with the Bullock Company for $400,000 of machinery and other equipment for the $1,000,000 plant his company is establishing in the Crescent City.

ROCK HILL, S. C.—A number of cotton mills at Rock Hill are contemplating installing electrical machinery to operate the mills by power from the Catawba Electric Power Company's plant at Fort Mill, S. C.

SPRINGFIELD, TENN.—The town of Springfield has secured the services of Granberry Jackson, of Nashville, to prepare plans for the new water and light plant. Bids will soon be called for.

SALT LAKE CITY, UTAH.—An Eastern syndicate, represented here by M. H. Boutelle and associates, has in view the purchase of the plant of the Salt Lake Water & Electrical Power Company, and with that end in view a postponement of the foreclosure case against the company has been secured. The property is of considerable value, and if the purchase is consummated, an additional plant will be installed by the syndicate.

THE ELECTRIC RAILWAY.

SAN FRANCISCO, CAL.—A new street railway company was formed recently under the name of the San Francisco Railway Company. Its capital was placed at $1,500,000, and the incorporation papers state that it is proposed to build street railways in this city. The promoters of the scheme are little known in the business and financial world, but declare that they have already received the means to build the proposed lines. They contemplate constructing a modern electric road from the water front to the beach, with a crosstown branch from the northern to the southern limits of the city. This is the first intimation of opposition to the United Railways, and the announcement of the company's intention has aroused keen interest. It is stated by well-informed street railway men that the company plans only to compel the United Railways to buy it out.

ATLANTA, GA.—A "Jim Crow" bill, providing separate compartments in street cars, has been introduced in the Georgia legislature.

BOISE, IDA.—A contract has been entered into between the Boise Traction Company and the Boise-Payette Power Company, whereby the latter is to furnish electrical energy for the operation of the traction company's street railway system.

CHICAGO, ILL.—The City of Chicago and the Union Traction Company have reached the parting of the ways. The local Transportation Committee, in whose hands is the traction problem, recently shut the doors against the bankrupt company, which operates the cars on the North and West Sides, and decided it must no longer operate.

LOUISVILLE, KY.—The stock of the Highland Railway Company in the Highland electric line, with the exception of that owned by John H. Shrader, will be transferred to the Louisville & Southern Indiana Traction Company, which recently purchased the road for $10,000 of the bonds of the traction company. The company will commence at once the work of reconstructing the line.

YAZOO CITY, LA.—E. P. Swain, J. F. Barbour and Mr. Kirkpatrick have applied to the City Council for a franchise for an electric railway here.

NEW ORLEANS, LA.—The directors of the New Orleans Railways Company have appropriated $1,500,000 for improvement of the conduit systems, the building of a power station, the construction of a lighting gasholder at the gas works and other improvements. The power station is to augment the equipment that is now located on the river front at the foot of Market Street, and when completed will be the largest power house in the South.

BALTIMORE, MD.—The stockholders of the Baltimore & Belair Electric Railway Company have authorized the issue of $500,000 30-year, 5 per cent. gold bonds, with the International Trust Company of Maryland as trustee. The first section of the road, which is ultimately to reach from Baltimore to Belair, a distance of eight miles, has about been completed, and will be operated under contract with the United Railways Company of Baltimore. Rails and crossties to complete the road to the Gunpowder River are on the ground, and work on this, the second section, will be begun as soon as the first section is in operation.

HAVERHILL, MASS.—The Haverhill & Boxford Street Railway Company will shortly petition the city government for a franchise in this city.

JEFFERSON CITY, MO.—Articles of incorporation have been issued to the St. Joseph Interurban Railway Company, of St. Joseph. The road is capitalized at $100,000. The incorporators are George C. Sims, of Des Moines, Ia.; Alice M. Butler, Samuel F. Moore, James E. Patrick and John J. Lea, all of St. Joseph.

RENO, NEV.—A franchise has been granted to H. E. Reid and others of this city for an electric street railway system.

ROCHESTER, N. Y.—It is said that the Rochester & Lockport electric railway project is to be taken up again. The death of Colonel Ellsworth, who was interested in the scheme, caused operations to be suspended. Now it is said that the Transit Finance Company has succeeded to the interest of Colonel Ellsworth, and that the building of the line will be carried out by the John R. Lee Company, of Scranton.

CLEVELAND, OHIO.—An ordinance has been introduced in the City Council requiring all electric cars entering or operating in the city to carry jacks for use in case of accident.

TOLEDO, OHIO.—The Patrick Hirsch Construction Company has commenced active work on the grade for the Toledo & Northwestern Railway, which will run from Toledo to Ann Arbor, Mich.

NORWALK, OHIO.—The Sandusky, Norwalk & Mansfield Railway Company has been granted a franchise enabling it to build into the center of Norwalk. Grading for this line is now progressing rapidly.

CINCINNATI, OHIO.—The Cincinnati Interurban Company will spend $150,000 in improving its lines between Cincinnati city limits and Carthage. Fifty thousand dollars will be expended on new equipment.

MARIETTA, OHIO.—The Parkersburg, Marietta & Interurban Railway Company has placed a contract with the Westinghouse Company for a 400-kw Westinghouse-Parsons steam turbine, to be direct connected to a two-phase, 60-cycle, 2200-volt generator. The unit will be installed at Parkersburg to care for the local lighting load.

ALLENTOWN, PA.—The Hanover Central Electric Railway Company has filed an extension of its line from Third and Market Streets, West Bethlehem, on Third to Union to Bethlehem Borough, thence to Maple, to Goepp to the borough limits and return, making a loop of its line.

MONESSEN, PA.—J. K. Tener, president of the Charleroi National Bank, and C. F. Thompson, of Charleroi, have become interested in the Webster, Monessen, Bellevernon & Fayette City Street Railway. It is said the new interests will push the extension to Fayette City and Webster, completing the work by fall. A new car house and power house will be erected.

NASHVILLE, TENN.—There is talk of building an electric railway from Nashville to Chattanooga. Northern capitalists are said to be interested, among them Randolph D. Fitzgerald, of Rochester, N. Y.

PORT ARTHUR, TEX.—The Pleasure Pier Traction Company has been chartered with $10,000 capital. The incorporators are S. O. Latimer, John A. Young, D. F. Burch, C. A. Fisher. Geo. W. Woodworth, all of Port Arthur.

BEAUMONT, TEX.—The Beaumont Traction Company has been disposed of to the Southern Electric Securities Company, which was recently incorporated in New Jersey. The same concern also takes over the electric railways, light and gas plants at Natchez, Miss., and Jennings, La.

RICHMOND, VA.—The corporation commission has granted the right to the Chesapeake Transit Company to increase its capital stock from $1,000,000 to $1,500,000.

NORTH YAKIMA, WASH.—The Sunnyside Railway Company, with a capitalization of $500,000, has filed articles of incorporation. The articles stipulate that either steam or electricity may be used.

LA CROSSE, WIS.—At the annual meeting of the stockholders of the La Crosse & Onaska Railway Company the following officers were elected: President, S. Y. Hyde; vice-president, F. E. Nichols; secretary and treasurer, W. W. Schall. The directors are S. Y. Hyde, B. E. Edwards, Peter Valier, F. E. Nichols and W. W. Cargill. Mr. Hyde was elected to head the company.

THE AUTOMOBILE.

TAXING AUTOMOBILES.—The Finance Board of the Common Council, Newark, N. J., is considering the proposition to tax the owners of automobiles. There are about 600 automobile owners in the city, and the committee believes it could raise about $8000 by this means.

AUTOMOBILE SPEEDS IN CHICAGO.—Aldermen of the judiciary committee decided that ten miles an hour is the greatest speed at which automobiles can be operated in safety in Chicago, that no person under 18 years old should be allowed to drive a machine, and that the machines should be numbered. Two ordinances submitted for the regulation of automobiles, with these changes, were recommended for passage.

NEW INDUSTRIAL COMPANIES.

THE SOUTHERN ELECTRIC & MANUFACTURING COMPANY has been incorporated at Atlanta, Ga., with a capital of $100,000.

THE UNIVERSAL ELECTRIC CORPORATION has been incorporated at Boston, with a capital of $100,000. The promoters are Hiram P. Harriman, N. Ellsworth Reed, Lewis E. Reed, George M. Palmer and Hans Leibrich.

THE SOUTHERN CALIFORNIA ELECTRIC MIRROR ADVERTISING COMPANY has incorporated at Los Angeles with a capital stock of $50,000, of which amount $6000 has been subscribed. The directors are E. I. Tolle, Santa Ana; G. S. Butler, W. E. Hutchason, A. L. Haley and A. Janssen, Los Angeles.

LEGAL.

INJURY BY FALLING ARC LIGHT.—A decision in favor of plaintiff in the suit of Fish vs. Kirlingray Electric Company has been sustained on appeal by the Supreme Court of South Dakota. The court holds: 1. Where plaintiff was injured, while attending church, by the fall of an arc light, which defendant electric company had placed in the church under an agreement to keep the same in repair and furnish electricity and carbons therefor, a complaint alleging that the lamp fell by reason of the defendant's negligence in failing to keep the lamp in proper repair was not demurrable for failure to charge that defendant was the owner of the church, or of the light which caused the injury. 2. Where an electric company sold an arc light to a church under a contract by which the company was bound to furnish electricity and keep the light in repair, and by reason of its negligence in failing to properly repair the light, after notice, it fell, and injured plaintiff while attending services, defendant was liable for such injury.

NEW YORK WIRE SUBWAYS.—Justice Truax in the case of the West Side Electric Company against the Consolidated Telegraph & Electric Subway Company, has dismissed the complaint, with costs. Justice Truax in rendering his decision said: "It was held in the Ghee case (supra) that, under the provisions of the Greater New York charter, the consent that is required by section 61 of the Transportation Corporation law to confer a franchise upon a gas lighting corporation can be given only by the municipal assembly, through appropriate ordinance, and that in the City of New York the 'municipal authorities,' within the meaning of that term, as used in said section 61, whose consent is required to lay conductors for conducting gas through the streets of the city, are the municipal assembly. Section 61 of the Transportation Corporation law relates as well to electric light corporations as to gas corporations, and 'the consent of the municipal authorities' is required for gas corporations by subdivision 1 of the section, and for electric light corporations by subdivision 2 of the section. I consider the Ghee case as controlling."

MARCONI STOCKHOLDER SUIT.—The Board of Directors of the Marconi Company has authorized the issuance of a statement, in relation to the suit brought by Henry Gardner against the company and its directors, in which it is said that the complaint has not been served upon the company or upon any of the other defendants, the plaintiff having filed the complaint in court before service. The plaintiff, it is stated, is not a stockholder of record, and has never before been heard of as in any way interested in the company. The charges of mismanagement and insolvency in the Gardner complaint are declared to show that the person who drafted the complaint was entirely without information regarding the affairs of the Marconi Company. The statement concludes: "The Marconi Company is in the most satisfactory financial condition, having ample funds in its treasury for every purpose. Other than its obligations to make an annual payment to Mr. Edison for four years for his services and inventions, the company has no debts excepting ordinary current accounts aggregating less than $1,000, while the salaries, including the annual payments to Mr. Edison, amount to only about $22,000 a year."

PAYING TELEPHONE INTEREST COUPONS.—In the suit to foreclose a mortgage by the Morton Trust Company, trustee, against the Home Telephone Company of Trenton, on exceptions to the master's report, the Court of Chancery of New Jersey has sustained the report in part. Its decision is as follows, in brief: 1. Where third parties advance money to a corporation to pay interest coupons, which, by the terms of the mortgage securing the coupons and bonds to which they are attached, have preference over the bonds, and receive the coupons in return for their advances, in the belief that they succeed to the rights of the bondholders in the coupons by purchase, the bondholders may nevertheless insist on their mortgage lien free from the purchased coupons, unless they understood, or had reason to inquire, that the third parties were buying the coupons, instead of the corporation paying them. 2. Where interest coupons, having preference over the bonds to which they were attached, were turned over to the corporation by which they were issued, to be cashed, and were canceled as to the bondholders, no subsequent information, either to the bondholders, or to purchasers of the bonds from them, to the effect that the coupons were sold to third parties, instead of being paid by the corporation, would affect the rights of the bondholders or purchasers to hold the bonds discharged from the lien of the coupons. 3. A promise made to coupon holders to see that the fund arising on foreclosure sale would be sufficient to meet their claims was without consideration, where, if the promise had not been made, the coupon holders would not have taken any steps beyond securing that result. 4. There was no sale of interest coupons where the holders turned them over to the president of the corporation which issued them, at the company's office, for payment and cancellation, and were not informed by him or any one that he was purchasing the coupons, and had no reason to suppose that the corporation was not paying them. 5. Where interest coupons are presented to the corporation which issued them, and are taken up, whether the transaction amounts to a payment of the coupons, or a sale to a third party who advances the money to take them up, is a question of fact.

OBITUARY.

MR. EDWARD TREVERT BUBIER died at his home in Lynn, Mass., on July 5, of Bright's disease. Mr. Bubier, better known by his pen name of Edward Trevert, was born in Lynn in 1858, and learned the shoemaking business, working at the bench for a number of years. In later life he achieved prominence as a writer and compiler of electrical books for the use of beginners, and for a number of years conducted the business of the Bubier Publishing Company.

PERSONAL.

DR. S. S. WHEELER sailed for England on July 13, in order to make an automobile tour, and will not be back before September 1.

MR. JOSEPH HOLLOS, whose interesting article on the new Buda-Pest, Hungary, telephone exchange appears in our current issue, is chief engineer of the system.

MR. E. KILBURN SCOTT will be one of the party coming over in September from the British Institution of Electrical Engineers to attend the Electrical Congress in St. Louis.

MR. C. NESBITT DUFFY, of the Chicago City Railway Company, was married on Wednesday, July 6, to Miss Clara Cunningham, of Chicago. Mr. Duffy's many friends are greatly pleased to extend their congratulations to him on this occasion.

MR. HENRY FLOY, consulting electrical engineer, has just returned to New York from France. He went over to Europe in May, for a rest and vacation, and has made a trip through the Irish, Scotch and English Lakes, returning by way of Brussels and Paris.

MR. W. W. GIBBS.—It is suggested that Mr. W. W. Gibbs' latest venture in Philadelphia, the United Water Improvement Company, is aimed at control of the Philadelphia Water Works, just as his earlier promotion, the United Gas Improvement Company, acquired the Philadelphia Gas Works.

MR. W. S. BARSTOW, the consulting electrical engineer, of New York City, has just returned from a seven months' stay on the Pacific Coast. The large steam turbine plant of the Portland General Electric Company, as well as several large transmission systems out there, are being intalled under his supervision.

MR. EDWIN H. LUDEMAN, 39-41 Cortlandt Street, N. Y., has consummated arrangements to act as representative in New York and the northern portion of New Jersey for Robt. Wetherill & Company, builders of Corliss engines, etc., of Chester, Pa. He will also represent the Fitchburg Steam Engine Company, as heretofore.

MR. J. T. NIBLETT, M. I. E. E., of Horton Kirby, England, is now visiting this country in the interests of the storage battery with which his name is so prominently connected on both sides of the Atlantic. While here Mr. Niblett will investigate electrical conditions generally and inspect some of the leading plants.

MR. C. R. HEAP, of London, England, is now spending a month in this country, looking into electrical conditions. Mr. Heap is an American who has spent several years abroad, introducing novelties and specialties of an electrical and mechanical nature from the United States. He will visit St. Louis and go out to the Pacific Coast to see his brother, Col. Heap, the well known lighthouse expert and engineer, who will shortly retire from the army with the

grade of brigadier general. While on this side, Mr. Heap desires to form new connections for agencies in England, and can be addressed at these offices.

MESSRS. WADDELL & HEDRICK.—The well-known firm of Waddell & Hedrick, consulting bridge engineers of Kansas City, Mo., have opened offices at the Manning Chambers, Toronto, Can., and at 165 St. James St., Montreal, Can., where they will be represented by Mr. M. C. Delano, Jr., M. E., and Mr. G. B. Ashcroft, A. M. Can. Soc. C. E. This firm has just completed the large bridge over the Fraser River at New Westminster, B. C., and will prepare the plans for the Straits of Canso bridge. The latter is destined to be the largest bridge of its type in Canada, and in fact the longest clear span cantilever structure in existence.

Trade Notes.

CLIFFORD H. BROWN & COMPANY, manufacturers of silvered mica condensers, have moved their office and factory to 2295 Seventh Avenue, New York.

THE CENTRAL ELECTRIC COMPANY, Chicago, is sending out circulars quoting some extremely low prices on porcelain tubes and insulators. The company is authority for the statement that it is prepared to make prompt shipment and it especially requests that all those who have not received its quotations should write for them.

SOLID BACK TRANSMITTERS.—The Conn. Tel. & Elec. Company, Meriden, Conn., has made a special offer to new customers on its solid back transmitter. This transmitter is scientifically and carefully made and is guaranteed not to pack or deteriorate with years of constant service. The tones are perfect and it has great volume. It is also moisture proof. The company states that it has made a permanent customer wherever one of these transmitters has been sold. Its new and enlarged catalogue is now ready and will be mailed on request.

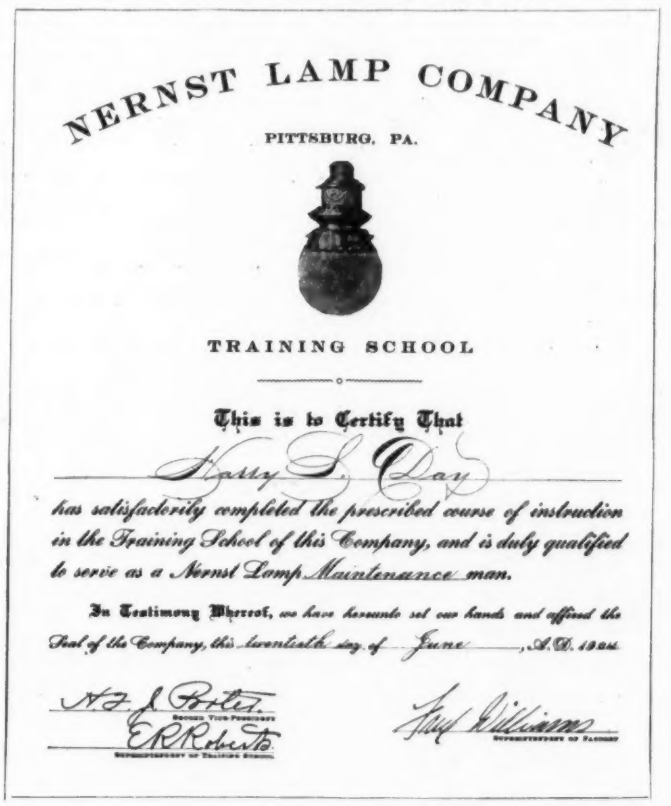
CHLORIDE ACCUMULATORS.—In bulletin No. 84, the Electric Storage Battery Company describes a number of recent installations of its accumulators for residential lighting and power purpose, among which we note plants in the residences of Mr. P. A. B. Widener and the late Mr. Wm. L. Elkins, at Elkins Park, Pa., and of Mr. A. G. Vanderbilt and Mr. C. F. Hoffman, at Newport, R. I. The bulletin contains cuts illustrating the battery rooms of the four residences mentioned above, and states that 152 private residences are equipped with "Chloride" storage batteries.

SOLDERING STICK ORDERS.—A valuable suggestion is contained in the following, dated June 23, and addressed to the L. B. Allen Company, Inc., 1332 Columbia Avenue, Chicago—"Kindly enter our order for — Allen soldering sticks to be shipped us via express. We have been very successful in our work using your make of stick, and lately have tried to procure them from the general supply dealers, but somehow we have always received some other make which they claimed was just as good. Our experience has been to the contrary." The above was received from a leading electrical manufacturing and repair company and tells a story.

SUCTION GAS PRODUCERS.—A type of gas producer which represents a new departure in this country, although thoroughly tried in Europe, is being placed upon the market by the Baltimore Gas Machinery Company, 14 W. Lexington St., Baltimore. In the first stage of the process, air is passed through a sufficient depth of carbon or coke and burns a portion of it to carbonic acid, which is reduced to the inflammable gas carbon monoxide. The second stage absorbs a portion of the heat evolved in the first stage. Steam is passed over highly incandescent carbon, the oxygen of the steam unites with the carbon and the hydrogen of the steam is liberated. The ultimate effect of the reaction is to decompose steam and produce hydrogen and carbon monoxide, giving a gas which is of great value for heating or gas engine purposes. The company claims that with electric power at 3 cents per hp-hour and producer coal at $6 per ton, 100 hp can be delivered at the switchboard by means of a gas producer plant at one-third the cost of the purchased electrical energy.

A WORKING MODEL CONCENTRATING PLANT built by the Allis-Chalmers Company, forms one of the most interesting features of the Utah exhibit in the Mines and Metallurgy Building, St. Louis. It is to be presented to the Utah School of Mines after the close of the Exposition. Every separate part of the plant has been lettered with descriptive legends, so that the onlooker, as he watches the plant at work, is able not only to see what is being done, but also to learn the name of the part that does the work. This makes the plant much more interesting as an exhibit and will add greatly to its value as an adjunct to the Utah School of Mines. The Allis-Chalmers Company is preparing to add an interesting feature to its large exhibit in the Mines and Metallurgy Building. This is a display of the various sizes of its crusher shafts. These shafts vary in size from 17 feet in length and seven tons in weight, to baby ones of only a few thousand pounds. These shafts will be exhibited each one hanging by its top from a great timber frame 18 feet in the clear in height and 18½ feet long.

NERNST LAMP TRAINING SCHOOL.—The accompanying illustration is a reproduction of a certificate such as the Nernst Lamp Company issues to those who complete a course in its Training School. This course runs from six weeks to three months, according to the previous training of the student. After


NERNST LAMP COMPANY

PITTSBURG, PA.

TRAINING SCHOOL

This is to Certify That

Harry S. Day

has satisfactorily completed the prescribed course of instruction in the Training School of this Company, and is duly qualified to serve as a Nernst Lamp Maintenance man.

In Testimony Whereof, we have hereunto set our hands and affixed the Seal of the Company, this Seventieth day of June, A.D. 1904.

N. J. Potter, Second Vice President

E. R. Roberts, Superintendent of Training School

Jas. Williamson, Superintendent of Factory

finishing the course the student is given an opportunity to show his ability in sales work as superintendent of maintenance department. If special ability is shown this will be properly recognized by advancements.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED JULY 5, 1904.

[Conducted by Rosenbaum & Stockbridge, Patent Att'ys, 140 Nassau St., N. Y.]

763,964. SAFETY TRAIN CONTROLING; George W. Cohen, Allegheny, Pa. App. filed Oct. 1, 1903. Means for warning the engineer and controlling the brake and steam supply for automatically stopping railway trains when any danger of collision exists, consisting in dividing the track into blocks, each separately included in an independent closed circuit provided with instruments adapted to co-operate with those carried by the locomotive.

764,005. GLOWER SUPPORT FOR SECOND CLASS CONDUCTOR LAMPS; Henry N. Potter, New Rochelle, N. Y. App. filed Oct. 9, 1902. Glower support for securing convenience of insertion and replacement, avoiding buckling of the glower and maintaining good electrical connection between the platinum leads.

764,006. HEATER FOR NERNST LAMPS; Henry N. Potter, New Rochelle, N. Y. App. filed Oct. 9, 1902. Details.

764,020. ELECTRICALLY PROPELLED VEHICLE; Russell Thayer, Philadelphia, Pa. App. filed April 11, 1904. An automobile, provided with an electric motor and storage battery, arranged to traverse the tracks of an overhead trolley system with the motor in operative connection therewith and to traverse a trackless roadbed independently of the trolley system. For use in connection with street railways for the purpose of enabling a car on a system which may become blocked, to pass from the tracks to the street surface in order to pass the obstruction and afterwards return to the tracks.

764,027. SOUNDER FRAME; Gustave A. Zundel, New York, N. Y. App. filed March 18, 1903. A bearing member having upwardly extending, laterally yielding, spring actuated bearing standards provided with sockets for the reception of the arbor of the sounder, whereby the use of adjusting screws for the bearings is dispensed with.

764,037. HANGER HANDLE FOR ELECTRIC LIGHTS; Patrick J. Cahill, Utica, N. Y. App. filed Sept. 17, 1903. An insulated handle consisting of two separable parts having projecting portions engaging the usual openings in the end of the lamp socket and having channels in the meeting faces to receive the conductor wires, and formed to provide a loop for receiving a supporting hook.

764,039. OVERHEAD TROLLEY; Clide C. Chambers, Everson, Pa. App. filed Feb. 25, 1904. Details.

764,043. RAILWAY SWITCHING APPARATUS; John P. Coleman, Edgewood, Pa. App. filed Oct. 7, 1903. The invention comprises operating mechanism for a railway switch and means whereby an indication is given that the operating mechanism has performed its functions.

764,044. PROCESS OF SMELTING AND REDUCING METALS; Christian Diesler, Coblentz, Germany. App. filed Jan. 12, 1901.

764,105. ELECTRIC ARC LAMP; André Blondel, Paris, France. App. filed Dec. 22, 1903. (See Current News and Notes.)

764,112. ELECTRICITY METER; Carlo Clerici, Milan, Italy. App. filed Nov. 30, 1903. Details of a meter in which the liquid always forms a continuous column and is never parted by the action of the current into two separate bodies.

764,135. ELECTRIC LIGHT HANGER FOR WALLS; Willy H. Lau, Chicago, Ill. App. filed April 23, 1904. A holder adapted to conceal an incandescent lamp from view when not in use and which enables the lamp to be readily brought out into position for use and simultaneously and automatically switched into circuit.

764,148. THIRD RAIL GUARD FOR ELECTRIC ROADS; John S. Payne, Midland Park, and James S. Payne, Wortendyke, N. J. App. filed July 23, 1903. This invention consists of a series of pivoted cover-plates in advance of each shoe, the plates descending as the shoes pass by.

764,169. INSULATED RAIL JOINT; George A. Weber, New York, N. Y. App. filed March 25, 1904. Details.

764,174. THERMO ELECTRIC ELEMENT; William H. Bristol, Hoboken,

N. J. App. filed Feb. 18, 1904. A couple particularly adapted for use in instruments for measuring high temperatures, in which one element consists of tungsten of wolfram steel and the other of nickel alloy.

764,175. THERMO ELECTRIC COUPLE; Wm. H. Bristol, Hoboken, N. J. App. filed March 5, 1904. The elements of the couple are reduced in cross-section at or near their junction for causing the couple to quickly respond to changes in temperature.

764,176. THERMO ELECTRIC COUPLE; Wm. H. Bristol, Hoboken, N. J. App. filed April 4, 1904. The terminals of the elements comprised in the couple are not directly connected, but are left in separated condition, the junction between the two being effected by a liquid metallic bath into which the terminals are introduced, and means in connection with said elements for measuring the difference of temperature at opposite ends thereof by means of the variation of electro-motive force due to the temperature at opposite ends of the dissimilar metals forming the couple.

764,177. THERMO ELECTRIC COUPLE; Wm. H. Bristol, Hoboken, N. J. App. filed March 5, 1904. A couple particularly adapted for use in pyrometers in which are connected with the elements of high fusing points, conductors of comparatively low resistance and having their junctions exposed to a temperature lower than or equal to the junction of the primary elements, whereby the use of special cooling means may be dispensed with.

764,178. THERMO ELECTRIC APPARATUS; Wm. H. Bristol, Hoboken, N. J. App. filed May 4, 1904. The apparatus comprises two separate elements, one of which consists in whole or part of the article to be heated or otherwise treated, an electrical measuring instrument in connection with the couple and a bath connecting the opposite ends of the couple.

764,181. STARTER FOR VAPOR ELECTRIC APPARATUS; Charles W. Denny, New York, N. Y. App. filed Jan. 27, 1904. The apparatus consists of a container, a liquid electrode and a solid electrode, a receptacle for the liquid electrode on one side of the container and a projecting lip on the solid electrode located on the same side of the container, the mass of liquid being sufficient to bridge the space between the electrode receptacle and the lip when the apparatus is in horizontal or normal position.

764,183. METHOD OF SEPARATING MECHANICALLY ENTRAINED GLOBULES FROM GASES; Thomas A. Edison, Llewellyn Park, N. J. App. filed Nov. 28, 1902.

764,189. ELECTRIC SWITCH; James F. Hardy, New York, N. Y. App. filed March 4, 1903. Details of a switch for controlling the movements of an electric motor shaft, the switch being constructed so that it may be operated by a part moved by the shaft when the same reaches a predetermined point, for automatically stopping the motor shaft.

764,194. TROLLEY DETAILS; Caleb Jones, London, Ky. App. filed Dec. 17, 1903. Details.

764,199. ALARM SYSTEM APPARATUS; Felix McGloin, Brooklyn, N. Y. App. filed May 23, 1903. Apparatus designed to send in a repeated alarm and so constructed that the sending in of an alarm from any one box cannot be seriously interfered with by the sending in of an alarm from any other box.

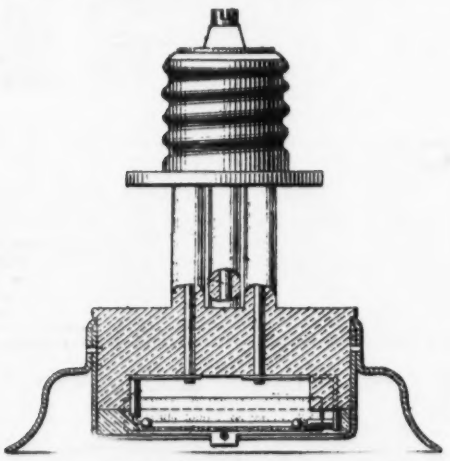
764,211. CURRENT COLLECTOR FOR ELECTRIC RAILWAYS; Frederick R. Slater, Yonkers, N. Y. App. filed Dec. 5, 1903. The third rail is provided with a cover or guard which is separated therefrom and projects inwardly from its inner edge, and the car is provided with a shoe adapted to bear against the side of the third rail and mounted upon a curved arm, whereby it may escape contact with the guard.

764,213. SYSTEM OF ELECTRICAL DISTRIBUTION; Charles P. Steinmetz, Schenectady, N. Y. App. filed Jan. 23, 1895. (See Current News and Notes.)

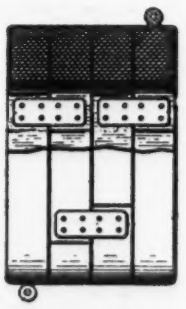
764,218. ELECTRIC CIRCUIT CONTROLLING APPARATUS; Jacob P. Tirrell, Boston, Mass. App. filed Oct. 10, 1903. Details of a switch particularly adapted for controlling the circuits of an illuminated sign.

764,224. TROLLEY; John Q. Brown, Oakland, Cal. App. filed April 12, 1904. Details of an overhead trolley particularly adapted for high speed, heavy, multiple-unit trains for interurban service.

764,244. THIRD RAIL SYSTEM FOR ELECTRIC RAILWAYS; Washington H. Kilbourn, Greenfield, Mass. App. filed Oct. 1, 1903. Guard rails are secured at opposite sides of and project above the third rail conductor, the same being separated from each other above the conductor by an arm-receiving slot and said guard rails being composed of sections insulated from each other and from the conductor.



764,005.—Glower Support for Second Class Conductor Lamps.



764,481.—Field Coil and Method of Making Same.

764,253. ELECTRIC METER; Albert Peloux, Geneva, Switzerland. App. filed April 13, 1903. The invention consists of an electric induction motor-meter, comprising a disk armature, a core, closed circuited windings on the core and a series coil, all on one side of the disk armature, and a core, shunt coils on said core and a separate core extending between the poles of the last mentioned core on the other side of the disk armature.

764,264. RAILWAY SWITCH; John E. Swonson, Des Moines, Ia. App. filed June 3, 1903. Details of a railway switch in which the movable switch points may be set to position by the operator on a car approaching the switch by means of an electric current taken from the trolley wire adjacent to the car.

764,282. BATTERY CELL; William O. Duntley, Chicago, Ill. App. filed Feb. 15, 1904.

764,293. ELECTRIC CIRCUIT CUTOUT; Charles Johnson and Claude Johnson, Memphis, Tenn. App. filed Aug. 20, 1903. Details.

764,349. ELECTROMASSAGE DEVICE; Lee J. Chapman, Columbus, O. App. filed March 12, 1904. The invention comprises two main parts, one consisting of the cell or generating factor provided with an electrode and the other embodying the coil having a regulating and interrupting attachment and provided with an electrode, the two being connected by a twin battery core and the whole device being arranged and insulated so that the two parts may be grasped by the operator and applied to the effected surface.

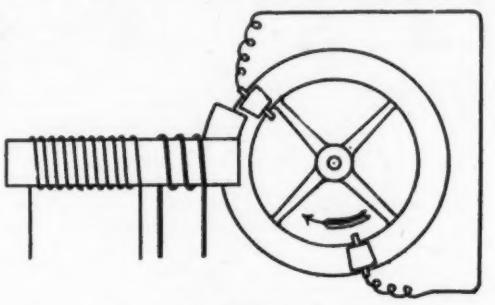
764,371. TROLLEY WIRE REPLACER; John D. Ratliff, Muncie, Ind. App. filed Feb. 15, 1904. Details.

764,372. THERMAL CUTOUT; Robert H. Read, Schenectady, N. Y. App. filed Oct. 23, 1902. The invention comprises a cartridge fuse containing granular material around the fuse and means for effecting a secondary break after the fuse has blown.

764,384. INSULATING SUPPORT FOR ELECTRIC THIRD RAILS; Frederick R. Slater, New York, N. Y. App. filed May 28, 1903. Details.

764,388. ELECTRIC RAILWAY; Henry N. Sporborg, Rugby, England. App. filed Dec. 9, 1902. A plurality of conductors are employed arranged parallel to the track rails and provided with switches for connecting them together and tripping coils adapted to be operated from a distant station for rendering the switches inoperative.

764,391. ELECTRICAL CONNECTION; Ernest A. G. Street, Courbevoie, France. App. filed July 15, 1903. The invention resides in a means for



764,518.—Electrical Heat Motor.

connecting electric conductors to conducting bodies, such as carbon blocks, plates or the like, particularly designed for use in connection with electric machines for the purpose of establishing an intimate contact between the conductor body and the conductor, and consists of a carbon brush, a conductor and a conducting body, channels formed in said body and clamping means applied to the opened out strands of the conductor at the channel extremities.

764,392. TROLLEY; Bernard E. Sunny, Chicago, Ill. App. filed Dec. 10, 1903. A current-collector for a double conductor electric system, comprising two members, one having a constant path of contact relatively to one conductor, and the other adapted to have a shifting path of contact relative to the other conductor.

764,400. CUTOUT FOR TROLLEY CONDUCTORS; Pendleton G. Watmough, Jr., Schenectady, N. Y. App. filed Nov. 1, 1901. The purpose of the invention is to insure safety to the public from broken trolley wires. A sectional trolley wire is provided, each sub-division of which is connected with a high potential feeder through a switch, the several sections being kept under tension by a weight which falls when the wire breaks and opens the switch contacts.

764,402. CONTROLLER; Elmer B. Wharton, Columbus, Ohio. App. filed Nov. 13, 1903. The device is particularly designed for controlling the movements of the winding drums of electric cranes and consists of details by which the operator may vary the speed of each motor employed independently of the others.

764,407. MEANS FOR CONTROLLING THE DIVISION OF LOAD BETWEEN SYNCHRONOUS MOTOR GENERATOR SETS; Jonathan E. Woodbridge, Albany, N. Y. App. filed Jan. 9, 1903. (See Current News and Notes.)

764,418. MULTIPLE TROLLEY; John S. Briggs, Los Angeles, Cal. App. filed June 1, 1903. Two current collecting wheels are provided, one of which is mounted in the fork of the pole and the other of which is connected thereto by a spring.

764,439. CONTROLLING SYSTEM FOR ELECTRIC MOTORS; Arthur C. Eastwood, Cleveland, Ohio. App. filed March 21, 1904. The purpose of the invention is to limit the current flowing through a motor at the instant of its reversal to a value which the motor will safely stand, and contemplates the use of means for automatically cutting out the starting resistance of the motor in such a way that the current flowing will not exceed a predetermined safe value.

764,469. TELPHERAGE SYSTEM; John H. Johnson, Dodgeville, Wis. App. filed July 18, 1903. The invention is to supplement and facilitate rural mail delivery, whereby the carrier may dispatch mail from the position of location of an ordinary letter box to the residence to which the letter box belongs with little or no more attention than is necessary to secure the deposit of mail in the usual way.

764,480. MOTOR CONTROL SYSTEM; John B. Linn, Schenectady, N. Y. App. filed Nov. 11, 1901. A controller of the separately actuated contact type is employed, in which the several controller contacts are arranged to be operated at a rate dependent upon the value of the current in the motor circuit by means of connections so arranged that the system will be automatic in its operations.

764,481. FIELD COIL AND METHOD OF MAKING SAME; Walter D. Litchfield, Schenectady, N. Y. App. filed Oct. 10, 1902. The coil of this patent is composed of a plurality of wound sections of copper conductor coated with a flexible enamel, a wrapping of cotton tape, insulating compound filling the interstices, an insulating wrapper and a protective wrapping soaked with an insulating compound.

764,485. TRANSFORMER; Walter S. Moody, Schenectady, N. Y. App. filed Dec. 14, 1903. (See Current News and Notes.)

764,499. BRUSH HOLDER; Henry G. Reist, Schenectady, N. Y. App. filed Nov. 25, 1898. The invention comprises a brush support, a sheet metal frame secured thereto formed of a single blank of sheet metal, provided with ears for connecting it with the support and ears for a pivot pin, and a brush follower mounted on the pivot pin.

764,505. ELECTRIC SWITCH; John L. Steeb, Butler, Pa. App. filed Sept. 29, 1903. Details.

764,518. ELECTRICAL HEAT MOTOR; Hugo Bremer, Neheim, Germany. App. filed Aug. 15, 1903. A magnetizable armature is employed adapted to move in a magnetic field which is rotated by being heated on one side only, the heating being effected by an electric current which is at the same time employed for producing the magnetic field.

764,533. AUTOMATIC ELECTRIC BLOCK SIGNALING; Wm. A. Luby, Kalamazoo, Mich. App. filed May 9, 1903. Details.

764,534. BURGLAR ALARM WINDOW FASTENER; Joseph Lyon, Dayton, Ohio. App. filed Aug. 14, 1901. Details.

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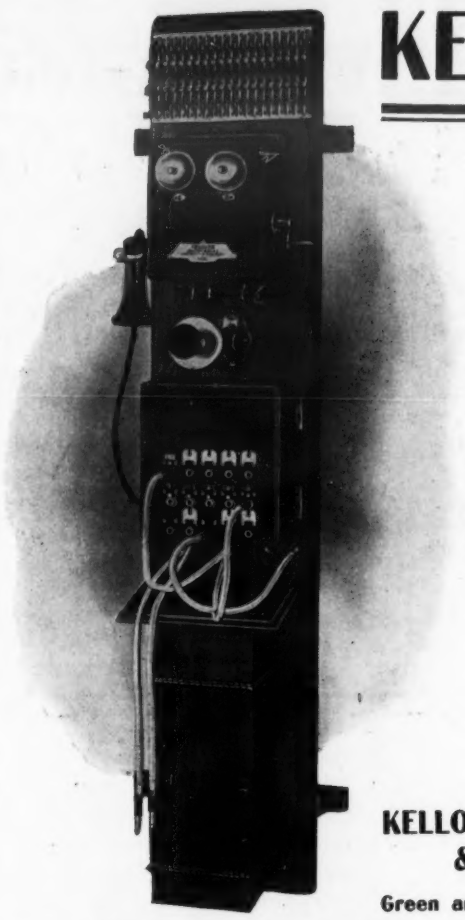

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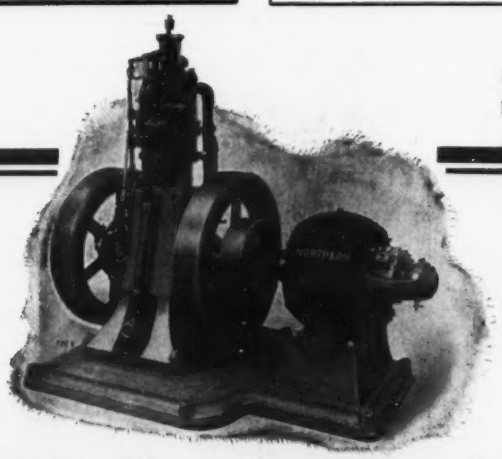

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